HYDROGEOLOGICAL INVESTIGATION OF PEEBLES STREET LANDFILL SITE, CALEDONIA

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HYDROGEOLOGICAL INVESTIGATION

OF

PEEBLES STREET LANDFILL SITE, CALEDONIA

Report prepared for:
Waste Site Evaluation Unit
Waste Management Branch

Report prepared by:
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EXECUTIVE SUMMARY

This report describes the results of a hydrogeological investigation of the closed Peebles Street Landfill in the Town of Caledonia. The investigation was initiated by the Ministry of the Environment to evaluate the impacts of the landfill, if any, on the ground water at the site, and to assess current and potential methane migration from the site.

Refuse deposition at the site is limited to a small area at the western boundary of the landfill property. The apparent operational method was end dumping over an embankment some 8-12 m high. The site is now well covered by a low permeability silty clay, and vegetation is flourishing.

The water table beneath the site is located in the bedrock approximately 7 m below the bottom of the refuse. There is also a perched water table condition in the overburden approximately 2 m below the refuse. Chemical analyses of samples from both the perched water and deep ground water, as well as samples from two residential wells, a mill well and a municipal well downgradient of the site clearly indicate that the landfill has no significant impact on ground water quality.

There are no perennial surface water courses on or adjacent the site, and there are no indications of adverse impacts on vegetation at the site by the landfill.

The hydrogeological investigation also addressed the issue of methane gas production and migration at the site. There is

no evidence of significant methane gas production at the landfill and therefore there is no risk to the adjacent town-house complex with respect to methane migration.

Some erosion of the steep slopes on the north and west sides of the site was observed during the investigation. It is recommended that appropriate measures be implemented to improve the slope stability.

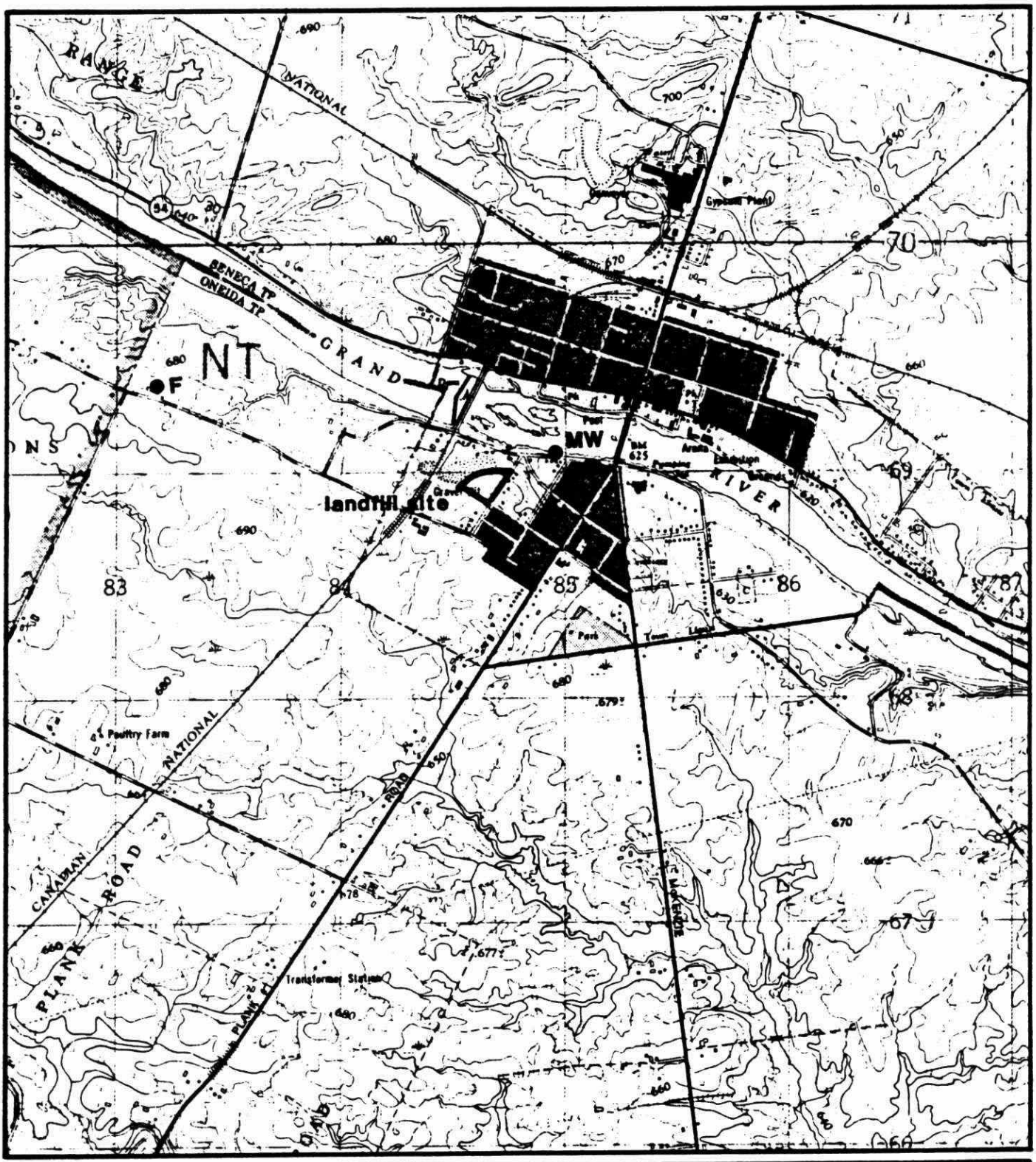
1. INTRODUCTION

In 1985, the Ministry of the Environment initiated a comprehensive program to investigate and monitor all active and closed waste disposal sites in Ontario. The main purpose of the program is to determine the existing impacts and potential for future impacts on the human and natural environments in the vicinity of the sites, and to assess the need for remedial works to mitigate these impacts.

In June 1988, M.M. Dillon Limited was retained to conduct a hydrogeological investigation of the closed Peebles Street landfill in the Town of Caledonia. The purpose of the study was to assess the impact of this waste disposal site on the quality of ground water and surface water at the site boundaries and to identify any need for remedial measures that may be required to prevent the migration of leachate/and or methane gas beyond the boundaries of the site.

1.1 Site Location

The Peebles Street landfill site is located in Lot 6 and part of Lot 5 in the southwestern part of the Town of Caledonia, Region of Haldimand-Norfolk (Figure 1). It is approximately 100 m south of the Grand River on the west side of Peebles Street. On the east side of Peebles Street there are six houses directly across from the landfill property. The site is bounded on the south by a 40 m wide stand of mature pine and hardwood, beyond which there are several houses on the west side of Peebles Street. To the west of the site are field and forest owned by the Canadian National Railway.



PEEBLES STREET LANDFILL

Scale 1 : 25,000

0 500 1000m

● MW MUNICIPAL WELL
● F FARM WELL

Location Map

FIGURE 1

North of the site, and within 10 m of the property boundary is a recently developed 36 unit townhouse complex. Between the townhouses and the Grand River there are several houses and a mill.

1.2 Site Background

Historically, there was a quarry operation which extracted sand and gravel from the Canadian National Railway (CNR) property and possibly the western edge of what is now the landfill property. The excavation resulted in a depression in the landscape adjacent to the landfill property.

According to a local resident, the Peebles Street property and the quarry pit have been used as a dump site for over 50 years. Common practice was to burn debris and push the ash and remnants into the former pit. There is still a visible spillover of debris onto the CNR lands, consisting of metal and concrete rubble. Aerial photographs taken in 1955 show that the site was very much the same then as it is currently, with dumping restricted to a small area along the western boundary of the site.

The first application by the Town of Caledonia for a Certificate of Approval for the Peebles Street site was made in May 1971 (see Appendix A). A provisional Certificate was issued (Appendix A) which stipulated that the site was to be used for disposal of non-putrescible wastes only. Domestic and commerical wastes from the Town were hauled to a privately operated landfill elsewhere (MOE files).

The last Certificate of Approval for the site expired at the end of 1979, and the landfill was closed at that time. Final cover was applied periodically until 1981. In March 1982 and August 1983, inspections of the site by Ministry of the Environment Environmental Officers revealed that there were no visible leachate springs or other problems, and that the site was in satisfactory condition (MOE files).

2. REGIONAL SETTING

2.1 Physiography and Climate

The Peebles Street landfill site is located in the physiographic region known as the Haldimand Clay Plain (Chapman and Putnam, 1966). The region is generally one of little topographic relief, with elevations typically ranging from 190 to 205 m above sea level (a.s.l.). In the vicinity of Caledonia, a series of exposed drumlins, rising to elevations up to 220 m a.s.l., provide an exception.

The Grand River Valley dissects the Clay Plain and is presently occupied by the misfit Grand River. The landfill site is located at the crest of the Valley, approximately 18 m above river level.

The weather station in the Town of Caledonia reports a 30 year annual mean daily temperature of 7.6°C. A 30 year mean annual precipitation of 913 mm is reported, comprising means of 769 mm rainfall and 146 mm snowfall (as equivalent rain) (Environment Canada, 1982).

2.2 Regional Geology

The Haldimand Clay Plain comprises predominantly glaciolacustrine sediments deposited by proglacial Lake Warren (Feenstra, 1975). This deposit consists of interstratified silt and clay, varying in thickness from 3 m near Hamilton to greater than 20 m near Dunnville (Ont. Dept. Mines, 1969).

In the immediate vicinity of the Town of Caledonia, a series of drumlins, which rest directly on the underlying bedrock, protrude through the glaciolacustrine deposits. The drumlins comprise the gravelly silt of the Wentworth Till.

Ice contact deposits consisting of silt, sand and gravel are also found in this area capped by the Lake Warren silty clay deposits. Sand and gravel have been extracted from these deposits at the former quarry operation adjacent to the land-fill site (Feenstra, 1975).

Total overburden thickness in the Caledonia area, south of the Grand River, varies between about 13 and 25 m, thinning towards the river.

Bedrock in the site area has been mapped as the Upper Silurian Salina Formation (MNR, 1975). The Salina Formation comprises brown dolomite and grey calcarious shale with gypsum. The gypsum is presently being mined by Domtar Ltd. along the northern boundary of Caledonia.

The bedrock surface, at an approximate elevation of 186 m a.s.l. in the study area, slopes gently to the southeast (OGS, 1981).

2.3 Hydrogeology

The major aquifer in the region is the bedrock. The Towns of Caledonia and Hagersville tap this aquifer for their municipal water supply. The quality of water from the Salina Formation is generally poor, and deteriorates with depth (MOE, 1980). As a result private well supplies are often augmented by the use of cisterns (MOE, 1974). One of the

Town of Caledonia's well, sampled by the MOE in 1972, is reported as having a sulphate concentration of 1186 ppm, 1440 ppm hardness and 2000 ppm total dissolved solids.

According to well records on file with the MOE there are eight drilled wells within 500 m of the site. All of these hit shale or shale and limestone at elevations between 185.3 and 188.3 m a.s.l. and all are reported to have yields exceeding 5 imperial gallons per minute (igpm).

The closest active municipal well to the landfill is located about 250 m northeast of the site (as shown on Figure 1). This well intersects a zone of high permeability in the upper 2 m of the bedrock and has a yield exceeding 2000 m^3 per day (300 igpm).

Static levels reported on well records indicate that the regional ground water flow is southeast. Locally, however, the flow appears to be influenced by and towards the Grand River.

3. FIELD PROGRAM

A detailed description of the methodology and protocols used in the field program is included in Appendix B. Briefly, the field program consisted of the following elements:

- Drilling and installation of seven ground water monitors into native soil at various on and off-site locations (see Figure 2). These comprised one nest of two piezometers at different completion depths in the overburden (P1), three single level piezometers in the overburden (P2, P3, and P4), and two monitors in the bedrock (B1 and B2). Borehole logs are included in Appendix C.

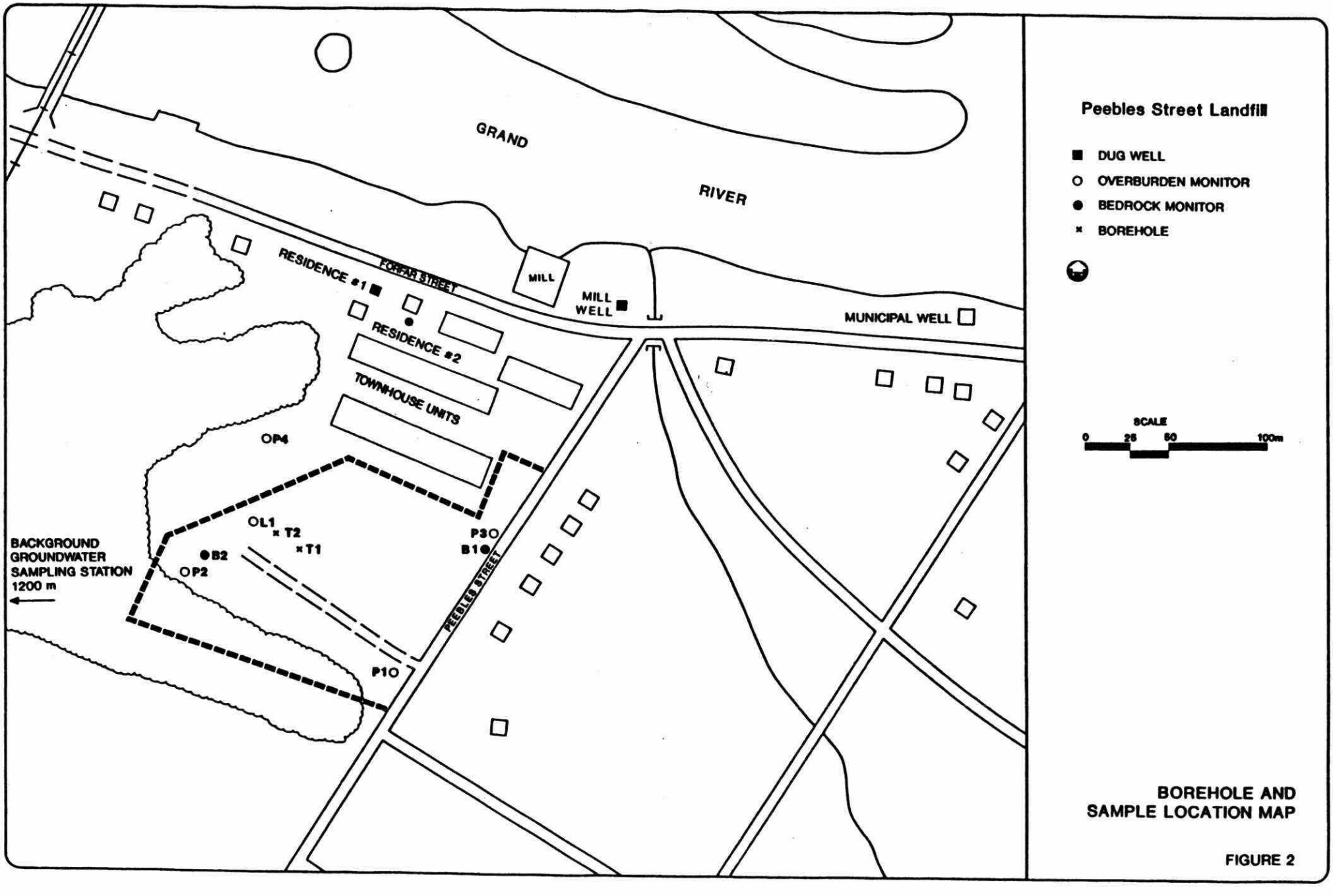
- Drilling of two test holes to determine depth and thickness of refuse (T1 and T2, Figure 2). Borehole logs are included in Appendix C.

- Drilling and installation of one standpipe through the waste for leachate monitoring and sampling (L1, Figure 2). Borehole log is included in Appendix C.

- Soil sampling with detailed descriptions and analyses. Grain size distribution curves are included in Appendix D.

- In-situ hydraulic testing of the various stratigraphic units. Rising head test data is included in Appendix E.

- Ground water sampling. All water quality is included in Appendix F.


GRAND
RIVER
FORFAR STREET
RESIDENCE #1
RESIDENCE #2
TOWNHOUSE UNITS
MILL
MILL WELL
MUNICIPAL WELL
OP4
OL1
T2
T1
P3O
B1
B2
OP2
P1O
PEEBLES STREET
BACKGROUND GROUNDWATER SAMPLING STATION 1200 m
Peebles Street Landfill
DUG WELL
OVERBURDEN MONITOR
BEDROCK MONITOR
BOREHOLE
SCALE
0
25
50
100m
BOREHOLE AND SAMPLE LOCATION MAP
FIGURE 2

- Leachate sampling from below the waste.
- Methane gas monitoring.
- Water level measuring.
- Vegetation assessment.

4. RESULTS

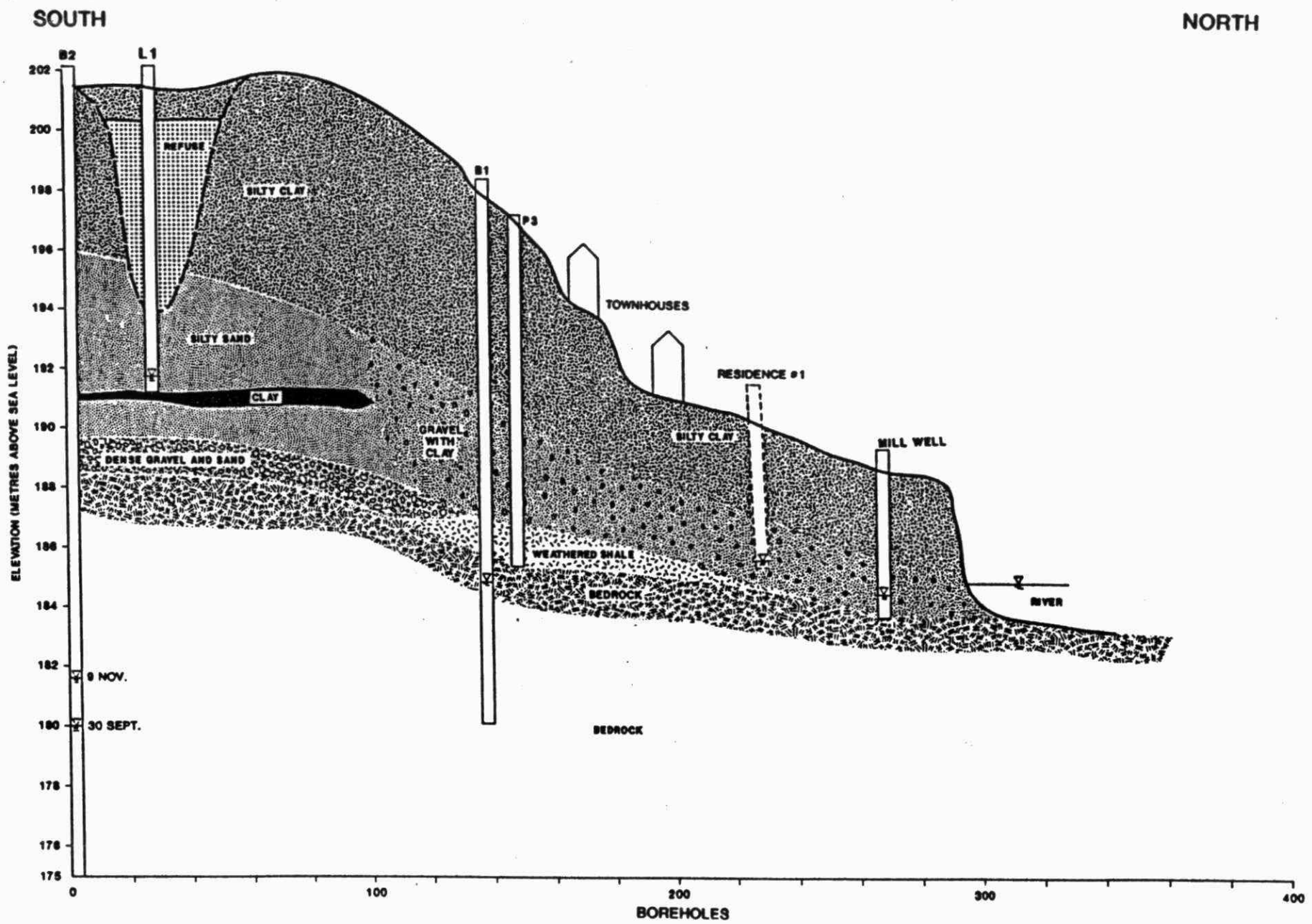
4.1 Stratigraphy

Grain size analyses were performed on five soil samples, selected as representative of the various stratigraphic units encountered. Table 1 summarizes the textural classifications and depositional histories of the samples, as inferred from their grain size distributions.

Figure 3 is a conceptual geological cross-section through the site, derived from borehole logs, well records, field observation and knowledge of the geological history of the area. Boreholes are shown on the section for the purpose of illustrating ground water elevations only. Because the section is conceptual, the stratigraphic interfaces encountered in the boreholes may not exactly match those illustrated.

In general terms, the stratigraphy in the site vicinity comprises silty clay glaciolacustrine deposits, overlying granular ice contact deposits, which in turn overlie the shale and limestone bedrock.

In the area above the Grand River Valley, where the landfill is located, the glaciolacustrine deposits range from approximately 5 m to 8 m thick. The underlying ice contact deposits range in thickness from about 7.5 m to 4.5 m, thinning towards the river, and comprise predominantly silty sand, with minor amounts of gravel. A thin clay seam (10 cm), with 0.25 m of saturated sand above it, was encountered within the ice contact deposits in borehole L1,



VERTICAL EXAGGERATION 10X

ALL STRATIGRAPHIC BOUNDARIES ARE INFERRED

BOREHOLES ARE SHOWN FOR ILLUSTRATING GROUNDWATER ELEVATIONS ONLY

PEEBLES STREET LANDFILL SITE

Conceptual Geological Cross Section

FIGURE 3

TABLE 1
SUMMARY OF SOILS ANALYSIS
PEEBLES STREET LANDFILL

Monitor	Sample Depth (m)	Soil Type	Inferred Deposit
P1	2	Silty clay	Glaciolacustrine
P1	6.4	Silty sand, little clay	Ice Contact
P1	10.6	Silty fine to coarse sand, gravelly	Glacial Till
P2	4.5	Silty fine sand	Ice Contact
P4	4.5	Silty fine to coarse sand, gravelly	Ice Contact

at a depth of 9.80 m. Although the clay seam was not specifically identified during drilling of boreholes P1, P2 and B2, the presence of saturated sand at similar elevations to L1 suggest that the low permeability layer is laterally extensive, dipping in a southeasterly direction. At the south end of the site, (borehole B2), the ice contact deposits are separated from the bedrock by a dense gravelly sand till approximately 3 m thick.

Within the Grand River Valley, the glaciolacustrine deposits thin from 5 m to less than 2.5 m at the river. The underlying deposits, which rest directly on the bedrock, range in thickness from 4.5 m to 1.5 m, and comprise predominantly gravel and course sand, with minor clay.

The upper bedrock in the vicinity of the site is reported in MOE well records as shale underlain by or interbedded with limestone. This is consistent with the bedrock boreholes drilled on-site and with the regional description of the Salina Formation.

Refuse was encountered in boreholes T1, T2, P2 and L1, beneath a silty clay cover between 0.4 and 0.9 m thick. The distribution of refuse thickness, summarized in Table 2, is consistent with reports of end-dumping of waste over the embankment. The refuse consisted of broken glass, concrete rubble, ash and vegetative debris.

TABLE 2
WASTE THICKNESS

Borehole	Thickness (m)
T1	0.85
T2	2.65
P2	0.61
L1	6.61

Aerial photographs of the site, taken in 1955 and 1979 confirm that disposal of debris was restricted to the western boundary.

4.2 Site Hydrogeology

Ground water elevations measured in the monitors on-site on several dates are summarized in Table 3. Also shown are ground water elevations measured in two dug wells (Residence 1, Mill Well, Figure 3) and the elevation of the Grand River surface. Borehole logs for the dug wells are not available, however they are likely terminated at, or slightly into the bedrock. Elevations measured on 15 August 1988 are plotted on Figure 4.

All the overburden piezometers on site, with the exception of L1, were consistently dry on six occassions between 28 July and 9 November 1988. In borehole L1, there was consistently less than 1 m of water (elevation 192.14-192.23 m) likely reflecting a perched water table on top of the clay seam found at elevation 191.76 m. This perched ground water likely flows southeasterly along the surface of the clay seam.

Ground water elevations in monitors B1 and B2 show the water table to be within the bedrock, and below the measured river elevation. In borehole B1, water was encountered under pressure at elevation 181.2 m approximately 3 m into the rock. The monitor produced a significant yield, indicating a zone of high permeability, and quickly achieved hydraulic equilibrium at a head of approximately 184.8 m. This elevation is consistent with those measured in the Residence #1 and Mill wells and it is likely that those wells are completed in the same high permeability zone.

Borehole B2 was drilled dry to a total depth of 27.64 m (bottom elevation 173.85 m). For four months after drilling, the monitor had shown continual recovery to an elevation of 181.71 m which indicates that a static level has yet to be achieved.

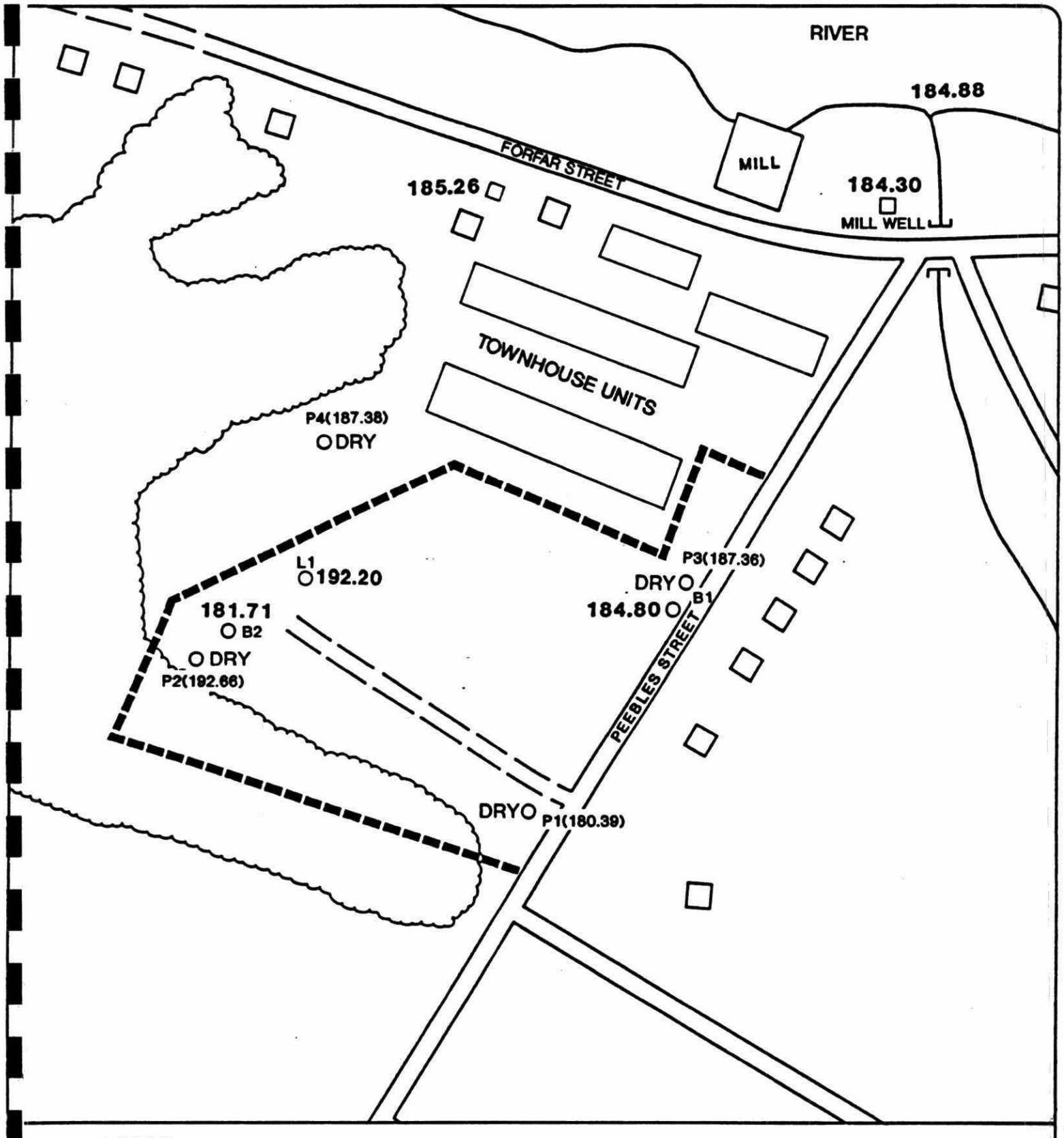
PEEBLES STREET LANDFILL

GROUNDWATER ELEVATIONS

TABLE 3

- DENOTES DRY WELL

MONITOR DESIGNATION	ELEVATION TOP OF PIPE (m.a.s.l.)	ELEVATION GROUND SURFACE (m.a.s.l.)	SCREENED DEPTHS BELOW SURFACE	JULY 28 1988		AUG. 15 1988		AUG. 31 1988		SEPT 7 1988		SEPT 30 1988		NOV 09 1988	
				READING (m)	ELEVATION (m.a.s.l.)	READING (m)	ELEVATION (m.a.s.l.)	READING (m)	ELEVATION (m.a.s.l.)	READING (m)	ELEVATION (m.a.s.l.)	READING (m)	ELEVATION (m.a.s.l.)	READING (m)	ELEVATION (m.a.s.l.)
P-1 I	202.07	201.79	11.90-13.40		-		-		-		-		-		-
P-1 II	202.09		8.50-10.00		-		-		-		-		-		-
P-2	201.66	201.18	8.25-9.00		-		-		-		-		-		-
P-3	196.96	196.75	8.10-9.60		-		-		-		-		-		-
P-4	193.88	193.78	5.75-6.50		-		-		-		-		-		-
B-1	198.44	197.68		13.69	184.75	13.63	184.81	13.75	184.69				-		-
B-2	202.16	201.49		26.46	175.70	22.10	180.06			23.30	178.86	22.02	180.14	20.45	181.71
L-1	202.25	201.56	8.75-10.25	10.02	192.23	10.04	192.21	10.07	192.18			10.06	192.19	10.11	192.14
RESIDENCE 1	191.24					5.98	185.26			5.92	185.32				
MILL WELL	189.08		5.67	4.67	184.41	5.78	183.30			4.72	184.36				
RIVER LEVEL					184.88										



SCALE

0 25 50 100m

LANDFILL PROPERTY BOUNDARY

L1 BOREHOLE IDENTIFICATION

181.71 GROUNDWATER ELEVATION M.A.S.L.

DRY(188.39) ELEVATION TO WHICH WELL IS DRY

Peebles Street Landfill

GROUNDWATER ELEVATIONS

(METRES ABOVE SEA LEVEL)

15 AUGUST 1988

FIGURE 4

It appears, from hydraulic heads in B1, B2 and the Mill Well, that the bedrock is recharged by the Grand River. However, the head in B1 is consistently higher than that in the Mill well indicating flow from south to north towards the river.

It is likely that the observed head distribution in the Mill well and monitor B1 is caused by the high rate pumping of the municipal well (MW, Figure 1) located 250 m northeast of the site, which is completed in the upper 2 m of the bedrock. This may explain why the Grand River is shown to be a zone of recharge rather than a zone of discharge.

Rising head tests were conducted at monitors B1, B2 and L1. The test data are included in Appendix E, and the results summarized in Table 4. Gross estimates of the bulk hydraulic conductivities of the unsaturated deposits were also made based on grain size distributions. These are also shown on Table 4.

The hydraulic conductivity for the saturated sand encountered in L1 is approximately 4.1×10^{-6} m/s. The hydraulic conductivities for the bedrock wells are estimated to be greater than 1×10^{-4} m/s for B1 and less than 2.1×10^{-5} m/s for B2.

The silty clay which caps the site has an estimated hydraulic conductivity in the order of 5×10^{-9} m/s. Hydraulic conductivities in the ice contact deposits range from 1×10^{-6} in the gravel with clay to 4×10^{-8} m/s in the silty sand. The dense till encountered in borehole P1 has an estimated hydraulic conductivity of 9×10^{-8} m/s.

TABLE 4
SUMMARY OF HYDRAULIC CONDUCTIVITY
PEEBLES LANDFILL

Monitor	Depth (m)	Formation	HYDRAULIC CONDUCTIVITY	
			Rising Head Test (m/s)	Hazen (m/s)
B-1		Shale/Limestone	$>2 \times 10^{-4}$	
B-2		Limestone	2.1×10^{-5}	
L-1		Silty sand	4.0×10^{-6}	
P1	2	Silty Clay		4.9×10^{-9}
P4	4.5	Silty Sand		1.0×10^{-6}
P2	4.5	Silty Sand		4.0×10^{-6}
P1	6.4	Silty Sand		4.0×10^{-8}
P1	10.6	Till		9.0×10^{-8}

4.3 Surface Water Flow

There are no perennial surface watercourses on or near the site. Runoff from the site is predominantly to the north and west, ultimately to the Grand River, located approximately 150 m north of the site. A small portion of the site drains to the south, through a culvert under Peebles Street into the Five Street ditch. This drainage also ultimately flows northward into the Grand.

4.4 Methane Gas

The methodology and protocol for the methane gas study are described in Appendix B. The gas meter used on-site actually detects total combustible gas. However, in the absence of other apparent gas sources, and as a conservative approach, the total combustibles were assumed to comprise only methane.

The results of the methane gas readings are shown on Table 5 and on Figure 5.

Methane gas in air is explosive only within a certain range of concentrations. The U.S. National Fire Protection Association (1978) has determined that the upper explosive limit (UEL) for methane gas is 150 000 ppm and the lower explosive limit (LEL) is 50 000 ppm.

The methane gas readings were found to be less than 123 ppm, (.25% LEL) at all 18 locations tested. There is no indication of significant methane gas production within the operational boundaries of the landfill site and subsequently there is no indication of methane gas migration outside of the landfill site boundaries.

A separate methane gas study was conducted by Peto MacCallum Ltd. (included in Appendix A) prior to construction of the townhouse complex adjacent to the property. That study also concluded that there was no methane gas at the property boundary.

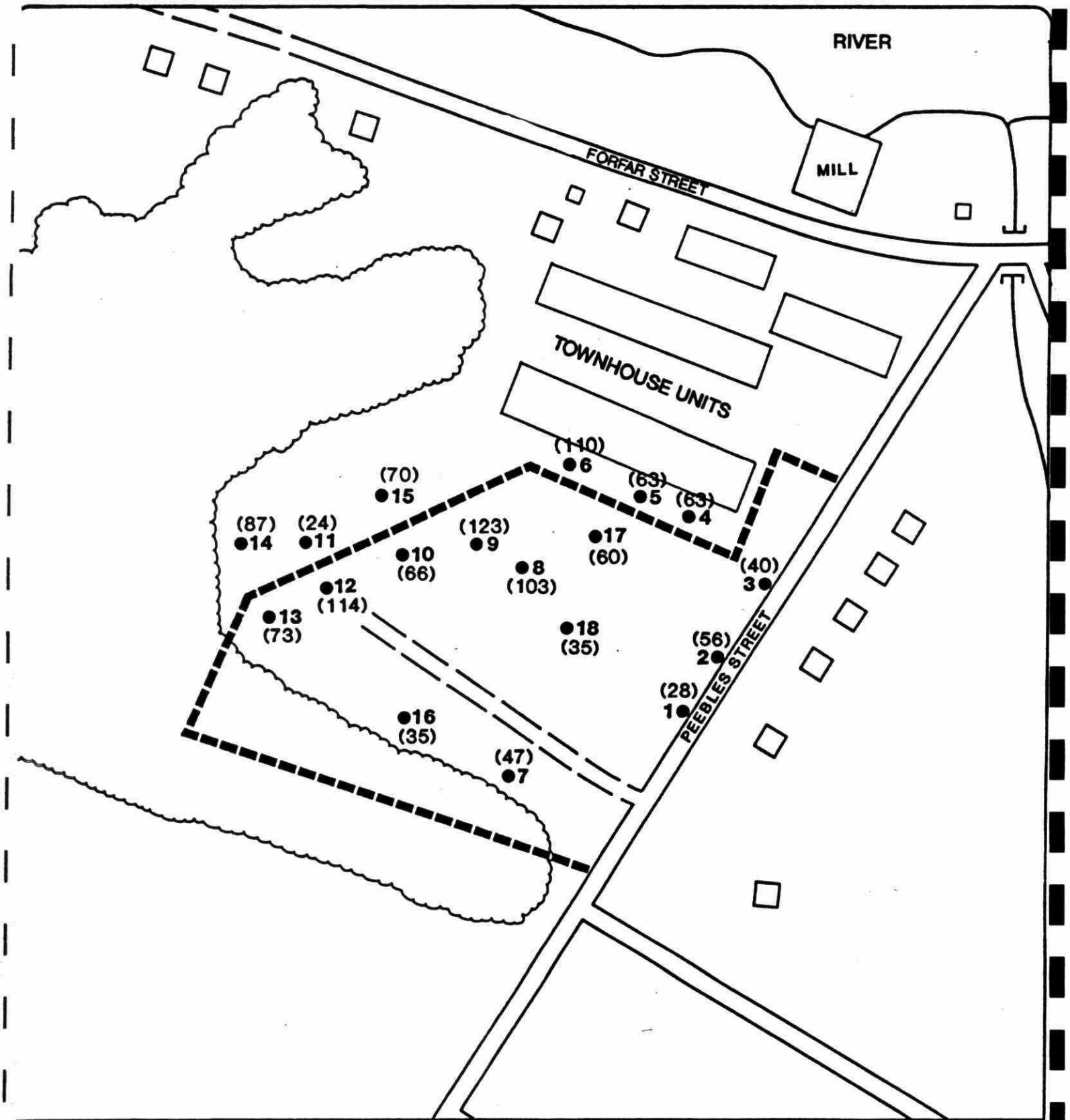
TABLE 5
METHANE GAS CONCENTRATIONS

Location[1]	Depth (m)	Concentration (ppm)	% LEL[2]
1	1	28	0.05
2	1	56	0.10
3	1.2	40	0.08
4	1.0	63	0.12
5	1.0	63	0.12
6	0.8	110	0.22
7	1.2	47	0.09
8	1.0	103	0.20
9	0.15	123	0.25
10	1.1	66	0.13
11	0.4	24	0.05
12	1.4	114	0.23
13	0.8	73	0.15
14	1.0	87	0.17
15	0.80	70	0.14
16	1.0	35	0.07
17	1.0	60	0.12
18	1.0	35	0.07

Notes:

[1] Refer to Figure 5.

[2] The lower explosive limit of methane gas is 50,000 ppm.



Peebles Street Landfill

METHANE GAS READING LOCATIONS

FIGURE 5

4.5 Water Quality

A total of nine samples were submitted to the laboratories for analyses. The sample locations include (see Figures 1 and 2):

- Borehole B1
- Borehole B2
- Borehole L1
- Mill Well (dug well)
- Residence 1 (dug well)
- Residence 2 (drilled well)
- Municipal Well (drilled well)
- Background Well (drilled well)
- Field Blank

The background sample was obtained from a farm well located some 1200 m northwest of the site (see Figure 1). Borehole data from MOE well records for this well, the Residence 2 well and the Municipal well is included in Appendix C.

The sampling protocol is described in detail in Appendix B.

Each sample was analyzed for a comprehensive suite of parameters, including:

- <u>General Chemistry</u>

Alkalinity	Field pH
Dissolved Organic Content	Field Specific Conductance
Ammonia	Field Temperature
Biochemical Oxygen Demand	Total Phenols

- <u>Major Ions</u>

Chloride	Bromide
Sulphate	Sodium
Nitrate	Potassium
Nitrite	Calcium
Fluoride	Magnesium

- Trace Metals

  18 Metals commonly associated with liquid and solid waste streams, including:

Iron	Copper
Arsenic	Lead
Cadmium	Zinc
Chromium	Mercury

In addition, to better characterize the leachate, the sample from borehole L1, obtained from beneath the refuse, was analyzed for a comprehensive suite of organic parameters, including:

- Volatile Organic Compounds

  A suite of some 35 of the more common volatile organic compounds.

- Polychlorinated Biphenyls (PCB)
  Pesticides and Herbicides

  17 chlorinated pesticides and six nitrogen phosphorus herbicides.

Insufficient water in the monitor and slow recovery prevented submission of a sample for analysis of acid and base/neutral extractable organic compounds.

The complete set of analytical data is included as Appendix F. Results of analyses for several of the inorganic parameters which best illustrate the character of the ground water are summarized in Table 6.

TABLE 6
PEEBLES STREET GROUND WATER CHEMISTRY

	BEDROCK WELLS (DEEP)					OVERBURDEN WELLS (SHALLOW)			Drinking Water Objective
	Farm	B1	B2	Res 2	Municipal	L1	Res 1	Mill	
General Chemistry									
BOD	1.0	9.5	265	2.5	1.0	5.5	1.5	2.0	10***
DOC	.70	2.80	74.2	.75	.35	-	5.90	1.07	5*
Phenols[2]	30.2	0.5	240	.5	<.5	<.5	<.5	.5	2*
Ammonia	.02	.59	21.5	.05	<0.2	-	.12	<.02	0.5***
Alkalinity	272	336	626	256	261	422	409	337	30-500*
ph (ph units)	7.07	6.86	6.78	7.01		7.5	7.05	7.05	6.5-8.5*
Conductivity	2500	3054	32,280	2274		1513	1174	1372	
Temp.	12°	12°	10°	18°		17°	10.5°	14°	
Major Ions									
Chloride	17.4	121	10400	17.7	28.3	24.5	28.2	164	250
Fluoride	<.10	<1.0	<1.0	<1.0	<1.0	<1.0	<.10	<.10	
Nitrite	<.10	<1.0	<1.0	<.10	<.10	<.10	<.10	<1.0	
Phosphate	<.10	<1.0	<1.0	<.10	<.10	<.10	<.10	< .10	
Sulphate	1140	1550	2460	1130	1130	316	167	136	500*
Nitrate	.69	<10	<.10	1.28	.86	6.59	2.91	3.44	10*
Magnesium	47.9	72.1	463	46.3	47.4	70.4	46.1	46.4	150***
Sodium	9.4	157	4530	11.0	16.2	36.1	24.4	63.2	20**
Calcium	571	594	1230	492	494	242	156	145	75***
Potassium	3.1	8.8	92.7	4.8	3.1	13.5	10.0	28.8	
Metals									
Boron	.183	.908	40.1	.152	.151	.366	.044	.037	5*
Iron	.10	.26	.58	.23	.05	.19	1.33	.09	0.3*
Manganese	<.01	.19	1.78	.11	<.01	.11	.04	<.01	.05*
Arsenic[2]	<1	1	50	<1	<1	<1	<1	<1	50**
Mercury[2]	.12	.08	<.05	.08	.12	.15	.08	.08	1**

[1] ppm $CaCO_3$
[2] ppb

Note: All values given in mg/L unless noted otherwise.

Drinking Water Objectives

* Maximum Desirable Limit (MOE 1983)
** Maximum Acceptable Ward (MOE 1983)
*** Health and Welfare Canada (1987)

The ground water sample obtained from beneath the waste in monitor L1 is not of a quality which would be considered leachate. The sample meets the guidelines and criteria for drinking water quality established by the MOE (1983) and Health and Welfare Canada (1987) for all parameters except sodium and calcium. However, the elevated concentrations of these cations are typical of the ground water quality in the overburden and better than that in the bedrock.

Of the organic analyses conducted on the sample from L1, the only positive determination was 4.49 ppb benzene. However, this result is not significant, given that 5.22 ppb benzene was reported in the travelling blank.

All samples from the bedrock were of the poor quality typically associated with the Salina Formation. Of note, however is the chemical character of the sample from borehole B2. The very high major ion concentrations (chloride, sulphate, sodium and calcium) are typical of very old, slow moving ground waters which have been exposed to evaporties such as halite, anhydrite, and in the vicinity of this site, particularly gypsum (MOE, 1980).

The elevated levels of BOD, DOC and phenols likely reflect a long residence time in a shale with a significant organic content.

4.6 Vegetation Assessment

The landfill is capped with a mixture of herbaceous species including grasses (a vigorous grass may be tall fescue) wild parsnip, birdsfoot trefoil, wild carrot and alfalfa. An

odour and some oily residue were detected associated with some uneven ground in the southwest corner. However, existing vegetation is generally healthy.

Slopes are steep along the northern and western sides of the site. Young trees including manitoba maple, elm, walnut, sumac, willow and poplar grow on the slopes. Recent construction of townhouses on the north side has led to significant slope disturbance and erosion. Vehicle travel has also damaged young trees on the western slope.

The southern side has a more stable situation with older trees of pine, walnut, ash, poplar and hawthorn.

Lower slopes and wetter soils further west from the landfill appear to contain generally healthy trees although thick undergrowth prevented extensive investigations.

In summary, leachate damage to vegetation appears to be minor. Eroded slopes on the north side should be stabilized and vehicle travel on the slopes should be restricted.

5. IMPACT ASSESSMENT

The refuse, which consists mainly of ash, wood, glass and minor amounts of oxidized metal, is situated well above the water table and is, for the most part, well covered by a low permeability silty clay. There is no evidence that the landfill has had or is having any impact on the naturally poor quality of ground water at this site.

There is no evidence of surface expression of leachate, or adverse impact on vegetation caused by the landfill.

The maximum measurement of 123 ppm total combustible gas (equal to 0.25% of the lower explosive concentration of methane) indicates that the site is not actively producing methane and therefore that migration to the adjacent townhouse complex is not a potential hazard.

6. CONCLUSIONS AND RECOMMENDATIONS

- The area actually used for disposal of debris on the Peebles Street landfill property is restricted to a small portion of the site along the western property limit.

- The landfill has no impact on the ground water quality at the site.

- The landfill does not affect the quality of water in the private wells located north of the site, or in the nearby municipal wells.

- There is no significant methane gas production at this landfill site.

- The landfill has no apparent impact on vegetation in the vicinity of the site.

- There is some erosion of the steep slopes on the northern and western sides of the site. These slopes should be stabilized.

REFERENCES

Chapman, L.J. and Putnam, D.F., Physiography of Southern Ontario, University of Toronto Press, Toronto, 1966.

Environment Canada, 1951-1980 Canadian Climate Normals, 1982.

Feenstra, B.H., Quaternary Geology of the Grimsby Area, Southern Ontario, Ontario Division of Mines Prelim. Map P. 993, 1975.

Freeze, R.A. and Cherry, J.A., Ground Water, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1979.

Health and Welfare Canada, Guidelines for Canadian Drinking Water Quality, Federal-Provincial Working Group on Drinking Water, 1987.

Hvorslev, M.J., Timelag and Soil Permeability in Ground Water Observations, U.S. Army Corps Engrs. Waterways Exp. Sta. Bulletin 36, Vicksburg, Miss. 1951.

Ministry of the Environment, Ground Water Probability, County of Haldimand, Water Resources Map 3112, 1974.

Ministry of the Environment, Ground Water Resources in the Grand River Basin, Technical Report Series, #10, Toronto, Ontario, 1980.

Ministry of the Environment, Water Well Records Updated 1983.

Ministry of the Environment, Ontario Drinking Water Objectives, Revised 1983.

Ministry of Natural Resources, Paleozoic Geology Grimsby, 1:50,000, Map 2343, 1975.

Ontario Geological Survey, Bedrock Topography Grimsby Area, Map P2401, 1:50,000, 1981.

Ontario Department of Mines, Drift Thickness Grimsby Street, 1:50,000, 1969.

U.S. National Fire Protection Association, "Fire Protection Guide to Hazardous Materials", Seventh Edition, U.S.A., 1978.

appendices

APPENDIX A
BACKGROUND MATERIALS

ONTARIO

Department of the Environment

For Head Office	
O	F
2nd Sheet	
#	

PROVISIONAL CERTIFICATE OF APPROVAL FOR A WASTE DISPOSAL SITE

Provisional Certificate No. 110101

Under **The Environmental Protection Act, 1971** and the regulations and subject to the limitations thereof, this Provisional Certificate of Approval is issued to

Town of Caledonia,

P.O. Box 359, Caledonia, Ontario

for the Landfill Site

located Peebles Street, Caledonia

subject to the following conditions

1. That only non-putrescible wastes be deposited at this site.
2. That all wastes are contained within the property owned by the applicant.
3. That the site is supervised on the day it is open and that at all other times entry is prohibited by a lockable gate.
4. That the area is maintained in a clean condition and that all wastes are covered when necessary to maintain a clean and workmanlike operation.

This Provisional Certificate expires on the 30th day of April, 1973

Dated this 8th day of June, 1972.

J. D. Keenan

Director, Waste Management Branch

FORM WM 308-2-72

REGIONAL ENGINEER'S REPORT

Subject : TOWN OF CALEDONIA waste disposal site

File # : A-1101

This application received from the Town of Caledonia is for a waste disposal site used only for non-putrescible wastes. All putrescible wastes are collected under contract to the Town and taken to a private waste disposal site.

This site of some 5 acres in size is open 1 day a week for non-putrescible wastes such as treee stumps, construction wastes, etc. This site has been inspected on numerous occasions and very little if any putrescible wastes have been noticed at any time. There have on occasion been several fires at this site and investigations made by the Air Management Branch. The Air Management Branch and the writer have met with the Town to discuss this site and the Town appear to be trying to co-operate in this matter. Unfortunately it is the usual story of too many keys having been passed around. There has been one complaint from a nearby resident made to this Branch and I believe several other Provincial agencies as well as to the Town and the Township of Oneida. This complaint seems to be boiled down to a squabble between the complainant and the Town and would not appear to have any bearing on the operation of the site.

It is recommended that a Provisional Certificate of Approval be issued to the Town of Caledonia for a waste disposal site to expire April 30,1973.

B.A.CREAMER, P.Eng.

WASTE MANAGEMENT BRANCH

RECOMMENDATION OF REGIONAL ENGINEER

FOR HEAD OFFICE USE	
FILE	A
ISSUE	
RE-ISSUE	
UP-GRADE	

NOTE: This form shall be submitted by the Regional Engineer to Head Office along with the application form and all supporting information.

APPLICANT: TOWN OF CALEDONIA, P.O.Box 359, Caledonia, Ontario.

FOR THE **WASTE DISPOSAL SITE** [X] | **WASTE MANAGEMENT SYSTEM** [ ]

LOCATED AT Peebles Street, Caledonia | SERVING

DATE APPLICATION RECEIVED: May 6, 1971 File: A-1101

ISSUE: Certificate of Approval [ ] Provisional Certificate of Approval [X] Provisional Certificate to Expire On April 30th, 1973

CONDITIONS:

1. That only non-putrescible wastes be deposited at this site.
2. That all wastes be contained within property owned by the applicant.
3. That the site be supervised on the day it is open and at all other times entry be prohibited by a lockable gate.
4. That the area be maintained in a clean condition and all wastes to be covered when necessary to maintain a clean and workmanlike operation.

CIRCULATE TO:

REASONS FOR CIRCULATING:

REFUSE APPLICATION: [ ]

REVOKE SUSPEND REFUSE TO RE-ISSUE (Cert. No.)

Department of Energy and Resources Management
Waste Management Branch

APPLICATION FOR A CERTIFICATE OF APPROVAL FOR A WASTE DISPOSAL SITE

TO: THE DEPARTMENT OF ENERGY AND RESOURCES MANAGEMENT
880 Bay Street,
Toronto, Ontario

To be submitted through Regional Waste Management Engineer

(1) Under the Waste Management Act, 1970 and the regulations, this application is made by The Town of Caledonia — *Owner of Facility*

P.O. Box #359, Caledonia, Ontario — *Address*

(2) for the ~~Renewal~~ / Issue of a Certificate of Approval for a — *Delete item inapplicable*

Land fill Site — *Type of Disposal*

(3) located Peebles Street — *Full particulars of Location*

Caledonia, Ontario

(4) A Certificate / Provisional Certificate of Approval No. ..... for this site was issued ..... 19..... — *Delete item inapplicable*

(5) No change in use, operation, or ownership of the site has occurred since the date of the original application.

Dated this 4th day of May 19 71

.....
Signature of Applicant

(6) The following changes in use, operation or ownership (have occurred since the date of the original application) (are proposed) — *Delete item inapplicable*

If necessary, provide additional details on separate sheets and attach to application.

.....

.....

Continued on Attached Sheets ☐

(7) The site will be operated in accordance with The Waste Management Act, 1970 and the regulations by The Town of Caledonia — *Name of Operator*

P.O. Box #359, Caledonia, Ontario. — *Address*

The required supporting information to the application is appended hereto.

(8) Notice of this application has been published in the.....

.....on..... .....and

.....19..... and a copy of the notice is attached.

(9) A certificate that the site does not contravene any of the by-laws of the municipality is attached. — *To be completed if applicant is other than a municipality*

See notes on sections 1 to 9 on back of last copy (pink) which is to be retained by Applicant.

Dated this 4th day of May 19 71

.....
Signature of Applicant

No Carbon Paper Required

Department of Energy and Resources Management
Waste Management Branch

SUPPORTING INFORMATION TO AN APPLICATION FOR APPROVAL OF A LANDFILL DISPOSAL SITE

For Head Office Use

1. Wastes to be Disposed of Comprise

Domestic	.....%
Commercial	.....%
Industrial Waste	.....%
Hauled Liquid Industrial Waste	.....%
Agricultural Waste	.....%
Hazardous Waste	.....%
Hauled Sewage	.....%
*Other	...100...%
	100%

*Describe rubble, tree stumps and waste of non-putrescible type.

Total 2 Tons/Day

Population Served 3,000

2. Origin and Composition of Principal Components of Waste (other than domestic and commercial)

3.

Distance to Nearest Watercourse	2000....Ft.
Distance to Source of Potable Water	2500....Ft.
Distance to Dwelling	700....Ft.
Distance to Public Road	650....Ft.
Distance to Cemetery	5000....Ft.
Total Area of Site	5 Acres
Anticipated Life	20 Years

General Description of Site

open rolling land with ravine at back of site

4. Maximum Depth of Excavation Below Surface .....Ft.
Maximum Height of Fill Above Surface 20 Ft.
Type(s) of Material Encountered From Surface
Unknown
.....Ft.
.....Ft.
.....Ft.
Depth of Watertable Below Surface Unknown Ft.
on ..... (Date).

5. Proposed Future Land Use

Residential

6. Operating Equipment

Bulldozer

Hours of Operation
Saturday 1 - 4 P.M.

7. The Following Documents are Attached

Prepared by

FOR DEPARTMENTAL USE

8. Authorities Consulted:

Health Unit	☐ Objection	☐ No Objection
O.W.R.C.	☐ Objection	☐ No Objection
A.M.B.	☐ Objection	☐ No Objection
Municipality	☐ Objection	☐ No Objection
Conservation Authority	☐ Objection	☐ No Objection

Other.....

Inspection Record Forms Attached

Regional Engineer's Report Attached ☐

RECOMMENDATION

.....TED

Peto MacCallum Ltd.
CONSULTING ENGINEERS

April 28, 1987 Our Ref: 87F171

Mr. D. Pearson
Slack Lumber & Supplies Ltd.
P.O. Box 579
Caledonia, Ontario
N0A 1A0

Dear Mr. Pearson

Methane Monitoring
Grand River Mills Townhouses
Caledonia, Ontario

We are pleased to inform you of the factual aspects of the work carried out on April 21, 1987 with respect to the above noted project. The project involves development of a townhouse complex on the property which backs onto a landfill site.

Four (4) holes were augered to a depth of approximately 8.0 ft. below existing grade and standpipes installed at the locations shown on Drawing 1 for purposes of monitoring the presence of methane.

A major, very stiff clay deposit was encountered throughout in boreholes 1 to 3. The clay layer was underlain by a sand and gravel unit at the 4 ft. depth in borehole 4.

No methane was detected during augering in any of the test holes.

We trust our work is complete within our terms of reference. The results of future monitorings for methane gas will be reported in due course.

Sincerely

Peto MacCallum Ltd.

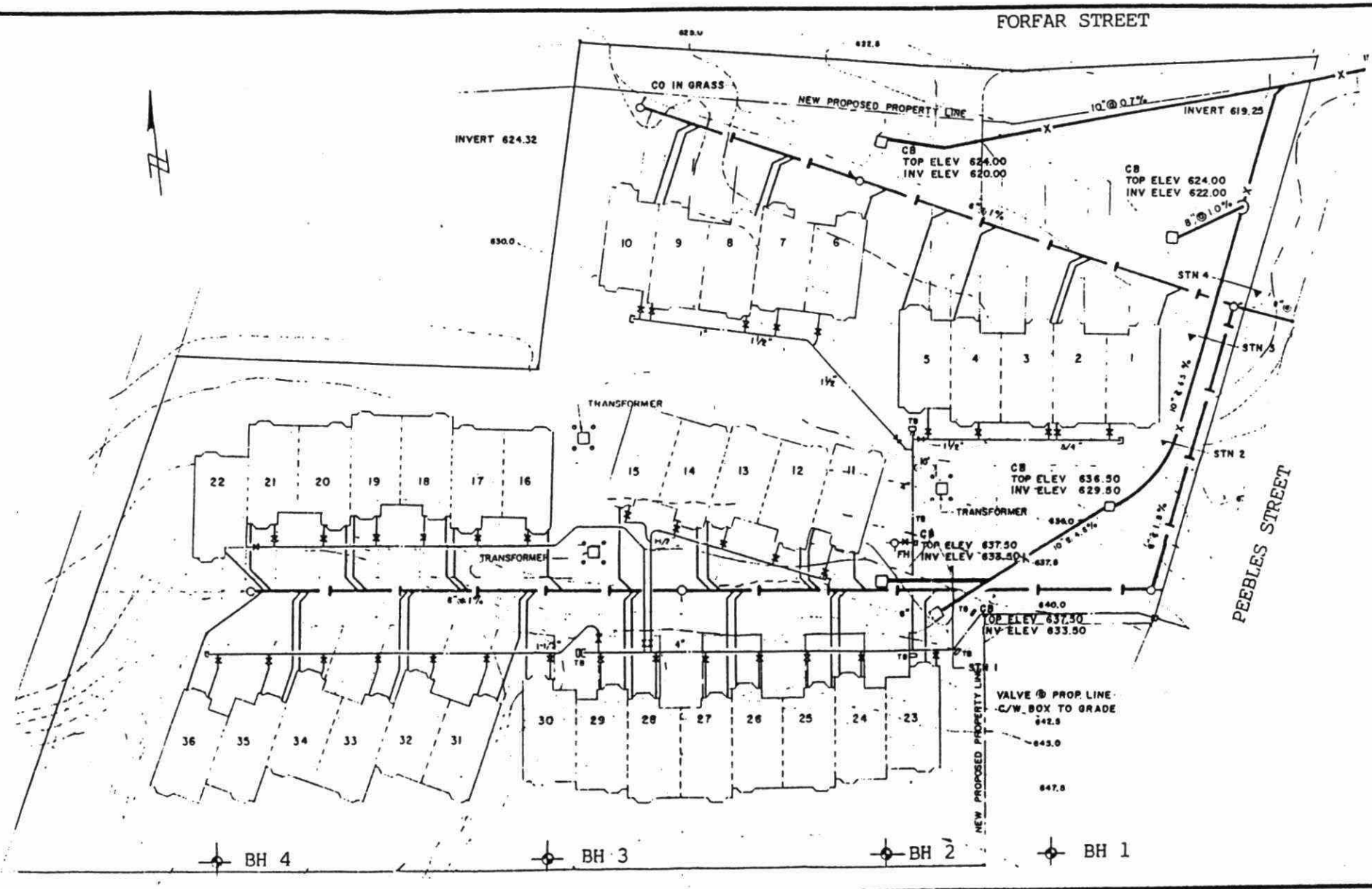
f.

Brian R. Gray, P.Eng.
Vice President
Geotechnical Engineering

SWB:rp

Enclosures: (1)

4 cc: Client



SLACK LUMBER & SUPPLIES LTD.			
Methane Monitoring Grand River Mills Townhouses, Caledonia			
BOREHOLE/STANDPIPE LOCATION PLAN			
DATE	SCALE	JOB NO.	DRAWING NO.
April '87	1" = 60'	87 F 171	1

PetoMacCallum Ltd.
CONSULTING ENGINEERS

APPENDIX B
FIELD PROGRAM METHODOLOGY AND PROTOCOLS

APPENDIX B
BACKGROUND INFORMATION

B.1 Drilling Program

The on-site drilling program initiated on 12 June 1988 and was completed 19 July 1988. A total of eight monitors were installed: four perimeter installations (P1II - P4) into the shallow overburden, one intermediate installation (P1I), into the till, two deep installations (B1, B2) into bedrock and one installation (L1) into the refuse. Well logs and installation specifications are included in Appendix C. The installation locations are shown on Figure 2). Two holes T1 and T2 were drilled to determine limit of refuse.

The monitors were installed using a truck-mounted mobile (B61) power auger drill with 170 mm inside diameter (I.D.) augers. The bedrock drilling was done by the air rotary method.

B.2 Ground Water and Leachate Monitors

The monitors are constructed of Class 1, Grade 1, 50 mm diameter, flush threaded Schedule 40 PVC pipe connected to 0.5 m - 1.5 m lengths of No. 10 slotted PVC screen. The pipe meets ASTM D1784 Standards for PVC filler (only 200 mesh marble dust) and is high impact strength and uniform diameter. The pipe also meets ASTM F480 specifications for thermal plastic well casing. Pipe and screen are laboratory washed and individually wrapped in plastic prior to shipment to the landfill.

The screened interval in each installation was sand packed with Grade 3 washed silica sand. Bentonite seals were placed above the sand packed section to prevent vertical movement of water within the drill hole. The remaining space in each borehole was backfilled with drill cuttings. A 150 mm square steel protective casing with lockable cap was placed over the pipe stick-up at each installation. Specific monitor installation details are shown on the borehole logs in Appendix C

B.3 Formation Sampling and Analysis

Splitspoon samples were taken for detailed inspection of stratigraphic units. A total of 37 splitspoon samples were taken from seven boreholes (see borehole logs, Appendix C). The splitspoon samples were visually inspected, logged and then discarded. A total of five samples were submitted for grain size distribution analysis, as representative of the various stratigraphic units encountered at the site. The grain size distribution curves are included as Appendix D.

B.4 Water Level Measurements

Depth from top of PVC pipe to the static water was measured in all of the monitors on 15 August 1988 and in most of the monitors on five other occasions (28 July, 31 August, 7, 30 September and 9 November). To convert depth-to-water to geodetic elevations, the top of each installation was surveyed with respect to a surveyed catch basin on the adjacent property to the north.

B.5 In-situ Hydraulic Testing

On 31 August 1988, rising head hydraulic conductivity tests were conducted on monitors B1, B2 and L1. Each monitor was bailed as free of water as possible and the rate of recovery of the water in the monitor was recorded. Hvorslev's basic time lag method (Hvorslev, 1951) was then used to calculate the approximate bulk hydraulic conductivities over the screened interval of each monitor.

B.6 Water and Leachate Sampling

One suite of ground water samples was collected. The locations of the sampling stations are indicated on Figures 1 and 2. Samples were submitted to two independent laboratories for analysis. The results of all analyses are included in Appendix F. All organic analyses were performed by Mann Testing Laboratories Ltd. of Mississauga, Ontario. The remaining parameters were analyzed by Barringer Magenta Ltd.

B.6.1 Sampling Protocol

The following section details the protocol used in collecting water samples at each of the monitoring stations during the sampling program. Rigid adherence to the procedures outlined was required to ensure that representative samples were taken and that accurate laboratory determinations could be made. The sampling protocol was taken from the MOE report titled "A Guide to the Collection and Submission of Samples for Laboratory Analysis", July 1985. Field pH and conductivity measurements were taken in accordance with ASTM standard methods.

1. The depths to water surface in all monitoring wells were measured with an electric tape, from the top of the standpipe.

2. To ensure that ground water samples were representative of formation water, and not stagnant water from the well bore, a minimum of three bore volumes were purged prior to sampling. Purging and sampling was performed using a PVC bailer and a Teflon bailer at ground installations, and a copper bailer at leachate installations. Between monitors, the bailer and tubing were thoroughly rinsed with distilled water, to prevent cross-contamination.

3. Ground water samples were collected using a PVC bailer. Surface water samples were collected by directly submerging the sample bottles below the water surface.

4. All samples were collected in new or laboratory washed and prepared bottles. Each bottle and cap were rinsed twice with sample water, prior to collecting the sample. Sterilized gloves were worn at all times to prevent contamination from the outside of the sample bottle.

5. Samples were collected in appropriate bottles and those for phenolic analysis were preserved with copper sulphate and phosphoric acid.

6. All samples were clearly labelled, stored on ice, and shipped to the laboratory within 48 hours of sampling. Strict adherence to protocol was maintained throughout the program.

7. To ensure quality control at the laboratory, duplicate samples and field blanks were submitted for analysis.

B.7 Methane Gas Monitoring

A portable "TLV Sniffer" was used to determine total combustible gas concentrations in 18 hand augered holes on and around the site, during the 14 July 1988 drilling program. The sample locations are shown on Figure 5.

To be conservative, it was assumed that all combustible gas was methane. The instrument is factory calibrated for hexane gas and by use of a multiplying factor (1.58) the ppm readings are easily converted to methane gas concentration.

Permanent methane gas monitors consisting of slotted 2.5 cm diameter PVC pipe were installed at each borehole.

B.8 Vegetation Assessment

The landfill site was studied by an experienced biologist to determine the effects of the landfill on the vegetation.

APPENDIX C
BOREHOLE LOGS

APPENDIX C
MOE WELL DATA

Farm Well MOE #26-448

Brown Clay	0 - 9.1 m
Gravel	9.1 - 11.9 m
Grey Shale	11.9 - 27.1 m

Water found at: depth 23.5m
elevation 186.8 m

Residence 2 MOE #26-1400

Brown Clay	0 - 2.1 m
Gravel	2.1 - 3.7 m
Shale	3.7 - 9.1 m

Water found at: depth 9.1 m
elevation 184.4 m

Municipal Well MOE #26-2003

Brown Clay	0 - 3.7 m
Brown Limestone	3.7 - 7.0 m
Grey Limestone	7.0 - 10.7 m

Water found at: depth 6.4 m
elevation 185.6 m

DILLON

BOREHOLE NO. P-1

PROJECT NAME Peebles Street Landfill

CLIENT MOE

PROJECT NO. 2283-01

GEOLOGIST / ENGINEER SED

DATE July 13 88

DESCRIPTION	Strata	DEPTH m	DEPTH ft.	SAMPLES no.	SAMPLES type	SAMPLES "N"	INSTAL. DETAIL	REMARKS
Ground Elevation (m a.s.l) 201.79								Protective Casing Stick-up I 0.28 II 0.31
Silty Clay		1 2 3 4 5 6	5 10 15 20		ss ss			Bentonite 25 mm Ø PVC pipe Native Material 50 mm Sch 40 PVC Pipe Bentonite
6.40								
Sandy Silt with little Clay		7 8 9	25 30					Native Material 1.5m #10 slot Screen Silica Sand
9.14								
Coarse wet Sand 10.05		10	35					
Silty fine to Coarse Sand Gravelly		11 12 13	40 45		ss ss ss			Clayey Native Material Bentonite Silica Sand 1.5 m #10 slot Screen
13.41								Dry Aug 15 88

DILLON

BOREHOLE NO. P-2

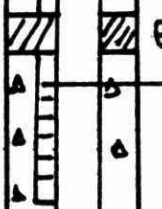
PROJECT NAME Peebles Str. Landfill

CLIENT MOE

PROJECT NO. 2273-01

GEOLOGIST / ENGINEER SED

DATE July 13 1988

DESCRIPTION	Stratg.	DEPTH m	DEPTH ft.	SAMPLES no.	SAMPLES type	SAMPLES "N"	INSTAL. DETAIL	REMARKS
								Protective Casing
Ground Elevation (m.a.s.l) 201.18								Stick-up = 0.48 m
Light Brown Cover		1						Bentonite
Refuse			5		grab			25 mm Ø PVC Pipe
Silty Clay		2						
4.47		3	10					Native Fill
		4						
			15		ss			50 mm Ø PVC Sch 40 Pipe
Silty fine SAND		5						
6.70		6	20		ss			
		7						
WET SAND 7.31			25		ss			Bentonite
SAND 8.53		8						Silica Sand
Silty FINE TO COARSE SAND DENSE, GRAVELLY		9	30		ss			.75 m #10 Slot Screen
		10						Bentonite
10.67			35		ss			
								Dry Aug 15 88

DILLON

BOREHOLE NO. P 3

PROJECT NAME Peeble Streat Landfill

CLIENT MOE

PROJECT NO. 2273-01

GEOLOGIST / ENGINEER SED

DATE July 13 88

DESCRIPTION	Strata	DEPTH m	DEPTH ft.	SAMPLES no.	SAMPLES type	SAMPLES "N"	INSTAL. DETAIL	REMARKS
Ground Elevation (m.a.s.l) 196.75								Protective Casing Stick-up = 0.21 m
Silty Clay 6.70		1 2 3 4 5 6 7	5 10 15 20		grab			Bentonite 25 mm PVC Pipe Native Backfill 50 mm Ø PVC Sch 40 Pipe
Dense Silty fine to coarse sand, gravelly 9.75		8 9 10	25 30 35		ss ss ss			Bentonite Silica Sand 1.5 m #10 Screen
Weathered Shale 11.43		11						Cave Material Dry Aug 15 '88
Shale Bedrock		12	40					Auger Refusal

DILLON

BOREHOLE NO. P-4

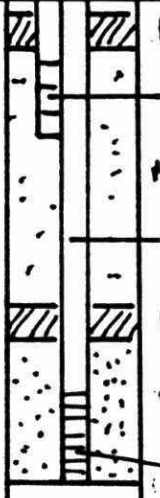
PROJECT NAME Peebles Street

CLIENT MOE

PROJECT NO. 2273-01

GEOLOGIST / ENGINEER SED

DATE July 14 1988

DESCRIPTION	Strata	DEPTH m	DEPTH ft.	SAMPLES no.	SAMPLES type	SAMPLES "N"	INSTAL. DETAIL	REMARKS
Ground Elevation: 193.78								Protective Casing Stick-up = 0.10m
Fill Material 1.50		1	5					Bentonite 25 mm Ø PVC Pipe Native Fill
Silty fine to Coarse Sand Gravelly		2 3	10		ss			50 mm Ø Sch 40 PVC Pipe
		4	15		ss			Bentonite
		5			ss			Silica Sand
		6	20					
Weathered Shale 7.62		7	25		ss			1.5 m #10 slot PVC pipe
Bedrock Shale		8						Dry Aug 15 88

DILLON

BOREHOLE NO. B-1

PROJECT NAME Peebles Street Landfill

CLIENT MOE

PROJECT NO. 2273-01

GEOLOGIST / ENGINEER SED

DATE July 15 88

DESCRIPTION	Strata	DEPTH m	DEPTH ft.	SAMPLES no.	SAMPLES type	SAMPLES "N"	INSTAL. DETAIL	REMARKS
Ground Elevation 197.68								Protective Steel Casing T.O.P. Elevation: 198.438 Stick-up = 0.76
Silty Clay		1	5					Bentonite
		2						25 mm Ø PVC Slotted
		3	10					
		4						50 mm Ø Sch 40 PVC Pipe
		5	15					
		6	20					
6.70		7						
Rounded Gravel with clay 7.92		8	25					Native Backfill
Silty fine to Coarse Sand Gravelly		9	30					
10.66		10						
		11	35					
Weathered Shale 12.0		12	40					
		13						
		14	45		SS			Aug 15 1988
SHALE		15	50					Bentonite
		16						
16.76		17	55		grab			Silica Sand 1.5 m Sch 40 PVC # 10 Slot
LIMESTONE 17.68		18			grab			

DILLON

BOREHOLE NO. B - Z

PROJECT NAME Peebles Street Landfill

CLIENT MOE

PROJECT NO. 2273-01

GEOLOGIST / ENGINEER SED

DATE July 18 88

DESCRIPTION	Strata	DEPTH m	DEPTH ft.	SAMPLES no.	SAMPLES type	SAMPLES "N"	INSTAL. DETAIL	REMARKS
Ground Elevation: 201.49								Steel Protective Casing 50 mm Sch 80 PVC Pipe Stick-up - 0.67
Silty Clay		1 2 3 4 5	5 10 15					Bentonite 25 mm Ø PVC hand Slotted Native Backfill
5.48								
Silty Fine Sand		6 7 8	20 25					
7.92								
Gravelly Sand		9	30					
9.14								
Silty Sand		10 11	35		SS			
11.58								
Gravelly Sand Dense		12	40					Bentonite
12.80								
Limestone with thin shale beds		13 14 15 16 17 18	45 50 55 60		grab			Bentonite

DILLON

BOREHOLE NO. B-2

PROJECT NAME Peebles Street Landfill

CLIENT MOE

PROJECT NO. 2273-01

GEOLOGIST / ENGINEER SED

DATE July 16 88

DESCRIPTION	Strata	DEPTH m	DEPTH ft.	SAMPLES no.	SAMPLES type	SAMPLES "N"	INSTAL. DETAIL	REMARKS
Limestone with thin beds of shale.		19	65					
		20						
		21	70					
		22						Native Backfill
			75					▽ Aug 15 1988
		23						
		24	80					
		25						
			85					Silica Sand
		26						
		27	90					
27.64		28						
			95					

DILLON

BOREHOLE NO. L 1

PROJECT NAME Peebles Street Landfill

CLIENT MOE

PROJECT NO. 2273-01

GEOLOGIST / ENGINEER SED

DATE July 19 88

DESCRIPTION	Strata	DEPTH m	DEPTH ft.	SAMPLES no.	SAMPLES type	SAMPLES "N"	INSTAL. DETAIL	REMARKS
								Steel Protective Cap
								50 mm PVC Sch 40 Pipe
Ground Elevation: 201.555								Stick-up = 0.70
0.15m								Bentonite
Silty Clay		1	5		grab			25 mm Ø PVC, hand slotted
		2						
		3	10		ss			Native Backfill
Refuse (Ash, Glass, Organic Material)		4	15		ss			
		5						
		6	20		ss			
		7	25		ss			Bentonite
7.62		8						
Silty Sand		9	30		ss			Grade 3 Silica Sand
9.80		10	35		ss			1.5 m #10 Slot Screen
Silty Clay 10.25					ss			Aug 15 88
Coarse Sand		11						

DILLON

BOREHOLE NO. T 1

PROJECT NAME Peebles Street Landfill

CLIENT MOE

PROJECT NO. 2273-01

GEOLOGIST / ENGINEER SED

DATE July 19 1988

DESCRIPTION	Strata	DEPTH m	DEPTH ft.	SAMPLES no.	SAMPLES type	SAMPLES "N"	INSTAL. DETAIL	REMARKS
Elevation 202.00								
SILTY CLAY								
REFUSE		1	5					Backfilled hole with native material
SILTY CLAY		2						
		3	10					

NOTE

REFUSE CONSISTED OF GLASS, ASH AND ORGANIC MATTER

DILLON

BOREHOLE NO. T2

PROJECT NAME Peebles Street Landfill

CLIENT MOE

PROJECT NO. 2273-01

GEOLOGIST / ENGINEER SED

DATE July 1988

DESCRIPTION	Strata	DEPTH m	DEPTH ft.	SAMPLES no.	SAMPLES type	SAMPLES "N"	INSTAL. DETAIL	REMARKS
Elevation 202.00								
Silty Clay 0.40		1	5		SS			Backfilled hole with native material
Refuse		2						
		3	10					
Silty Clay		4						
			15					

NOTE

REFUSE CONSISTED OF GLASS SHARDS, ASH and ORGANIC MATERIAL)

APPENDIX C
MOE WELL DATA

Farm Well MOE #26-448

Brown Clay	0 - 9.1 m
Gravel	9.1 - 11.9 m
Grey Shale	11.9 - 27.1 m

Water found at: depth 23.5m
elevation 186.8 m

Residence 2 MOE #26-1400

Brown Clay	0 - 2.1 m
Gravel	2.1 - 3.7 m
Shale	3.7 - 9.1 m

Water found at: depth 9.1 m
elevation 184.4 m

Municipal Well MOE #26-2003

Brown Clay	0 - 3.7 m
Brown Limestone	3.7 - 7.0 m
Grey Limestone	7.0 - 10.7 m

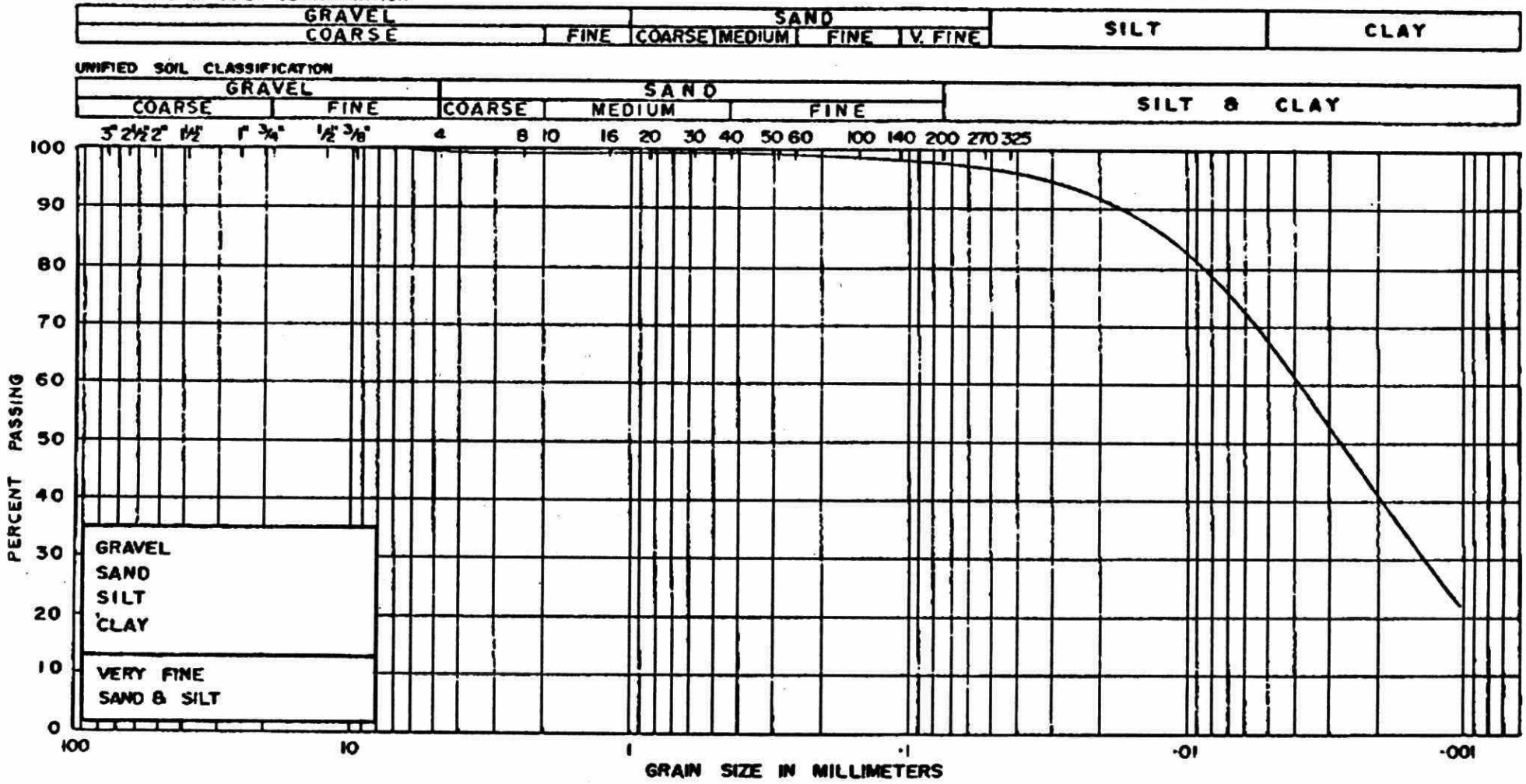
Water found at: depth 6.4 m
elevation 185.6 m

APPENDIX D
GRAIN SIZE DISTRIBUTION CURVES

Soil-Eng Limited

REFERENCE Nº 8809-M.77

GRAIN SIZE DISTRIBUTION



PROJECT:

LOCATION:

BOREHOLE Nº: P-1-6

SAMPLE Nº:

DEPTH:

ELEVATION:

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

Silty Clay

LIQUID LIMIT % =

PLASTIC LIMIT % =

PLASTICITY INDEX % =

MOISTURE CONTENT % =

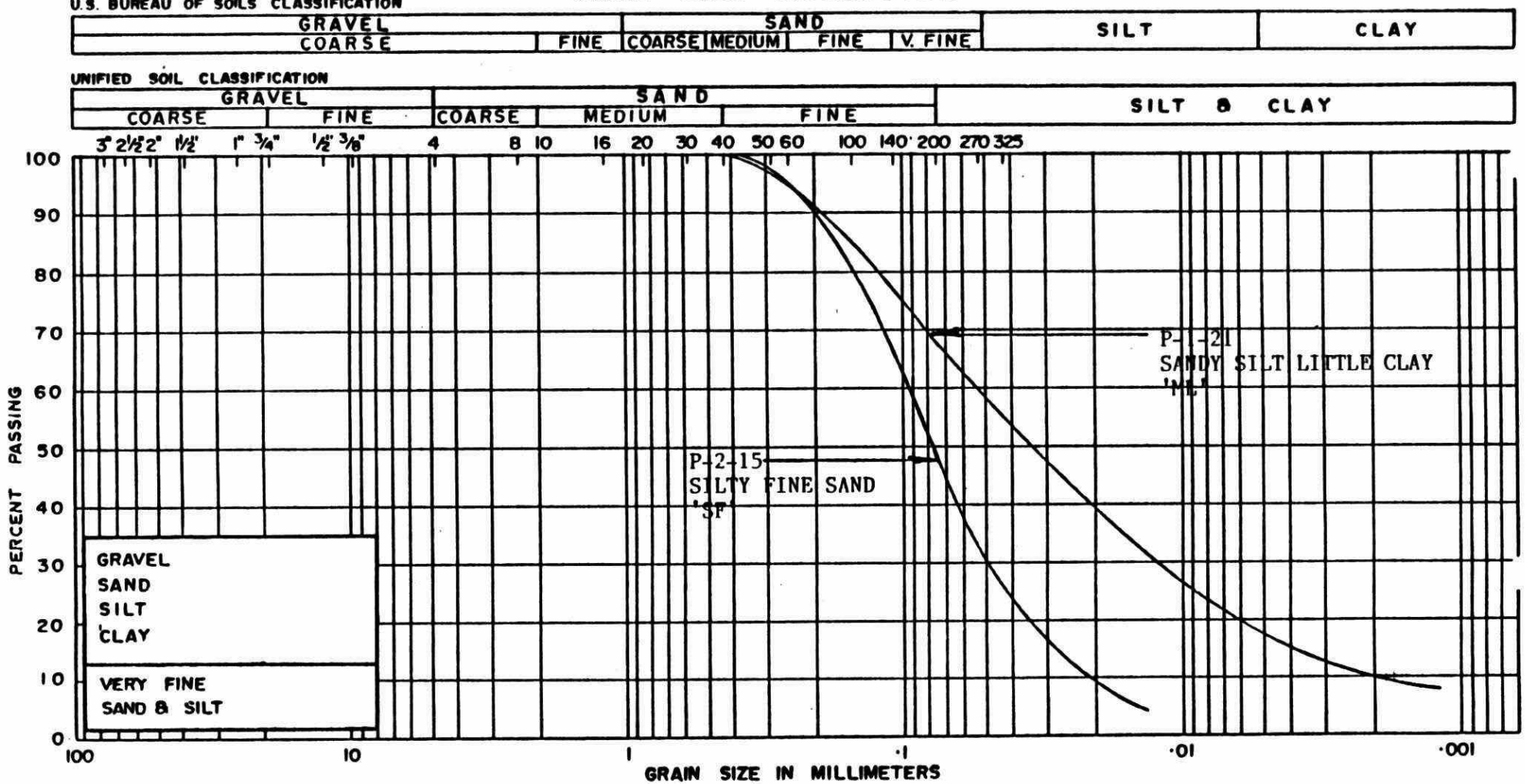
PERMEABILITY (cm./sec.) = 10^{-7} (Estimated)

FIGURE:

Soil-Eng Limited

REFERENCE Nº 8807-M.92

GRAIN SIZE DISTRIBUTION



PROJECT:

LOCATION:

BOREHOLE Nº:

SAMPLE Nº:

DEPTH:

ELEVATION:

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and 'Group Symbol':

LIQUID LIMIT % =

PLASTIC LIMIT % =

PLASTICITY INDEX % =

MOISTURE CONTENT % =

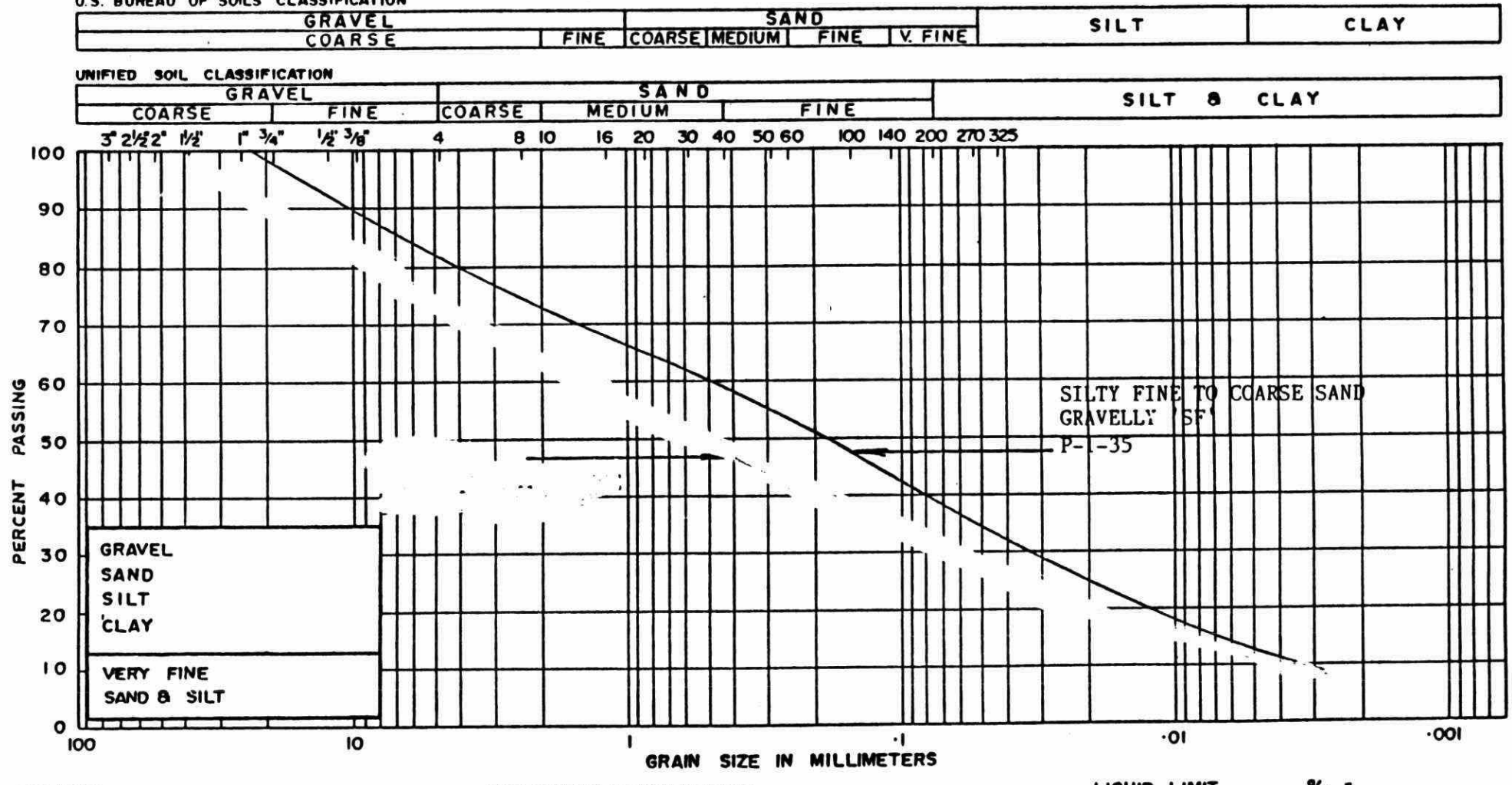
PERMEABILITY (cm./sec.) =

FIGURE 2

Soil-Eng Limited

REFERENCE Nº 8807-M.92

GRAIN SIZE DISTRIBUTION



PROJECT:
LOCATION:
BOREHOLE Nº:
SAMPLE Nº:
DEPTH:
ELEVATION:

COEFFICIENT OF UNIFORMITY:
COEFFICIENT OF CURVATURE:

Classification of Sample and 'Group Symbol:'

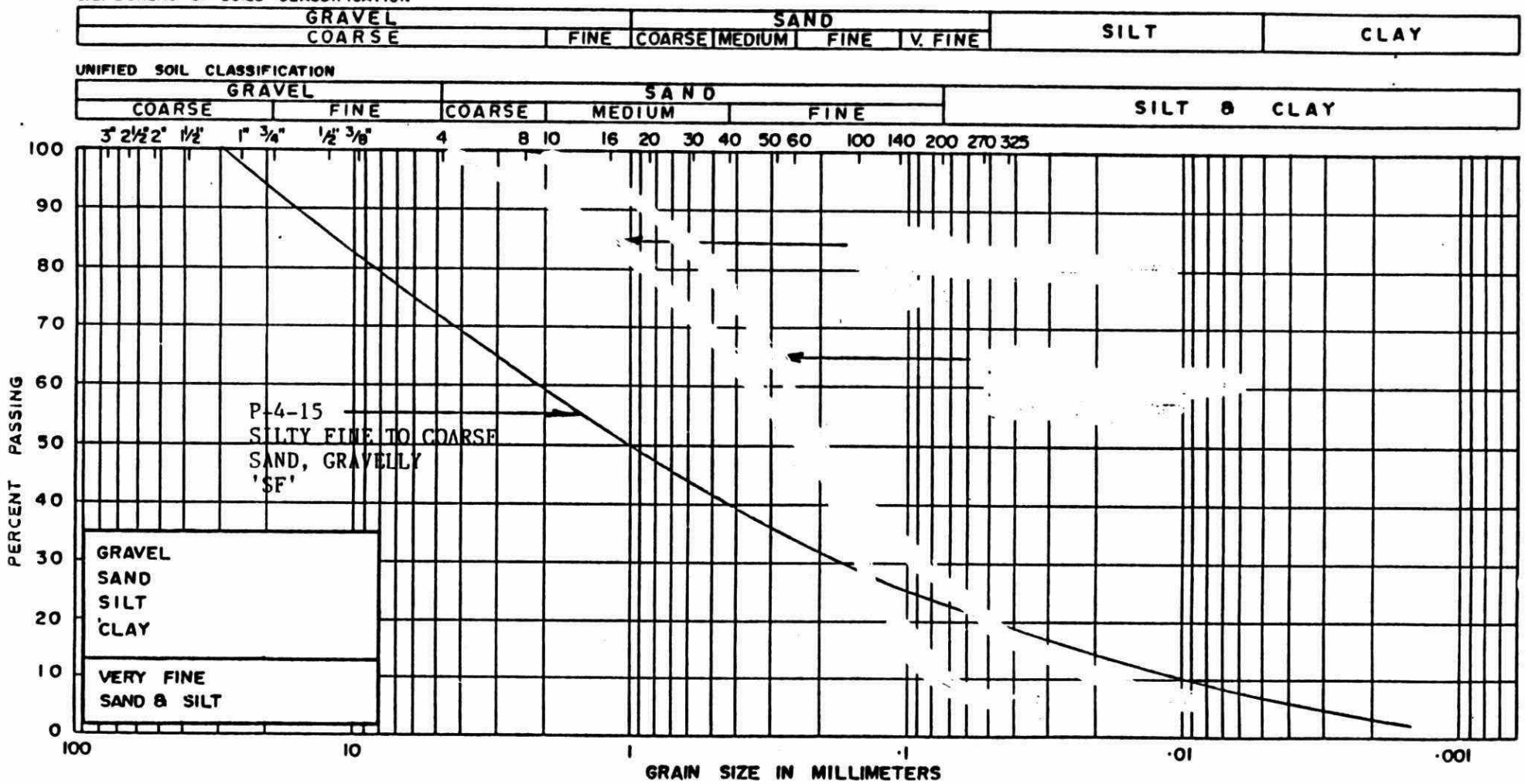
LIQUID LIMIT % =
PLASTIC LIMIT % =
PLASTICITY INDEX % =
MOISTURE CONTENT % =
PERMEABILITY (cm./sec.) =

FIGURE 3

Soil-Eng Limited

REFERENCE Nº 8807-M.92

GRAIN SIZE DISTRIBUTION



PROJECT:

LOCATION:

BOREHOLE Nº:

SAMPLE Nº:

DEPTH:

ELEVATION:

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and 'Group Symbol:'

LIQUID LIMIT % =

PLASTIC LIMIT % =

PLASTICITY INDEX % =

MOISTURE CONTENT % =

PERMEABILITY (cm./sec.) =

FIGURE: 1

APPENDIX E
RISING HEAD TEST DATA

DILLON

IN-SITU HYDRAULIC CONDUCTIVITY TEST

Project Name: MOE CLOSED File No: 22 3-01 Date: Aug 31

Borehole No: B-1 Conducted By: SED Page: 1

Static Water Level: 13.75 Measuring Point: T.O.P

Drawdown at t= 0 (Ho): 14.70

Date	Time (hrs. & mins.)	Elapsed Time (min)	Depth To Water (m)	Drawdown, H (m)	H/Ho	Remarks
	0	0	13.75	0	D	
		0:5	13.82	.07	0.08	
		.75	13.75			

DILLON

IN-SITU HYDRAULIC CONDUCTIVITY TEST

Project Name: MOE CLOSED (Peeble) File No: 2273-01 Date: Aug 31 '88

Borehole No: L-1 Conducted By: SED Page: 1

Static Water Level: 10.07 Measuring Point: T.O.P.

Drawdown at t= 0 (Ho): .21

Date	Time (hrs. & mins.)	Elapsed Time ( )	Depth To Water (m)	Drawdown, H (m)	H/Ho	Remarks
		:66	10.25	.18	.85	
		1	10.24	.17	.80	
		2	10.22	.15	.71	
		3	10.21	.14	.66	
		5	10.195	.135	.60	
		7	10.18	.11	.52	
		10	10.155	~~.145~~ .085	.40	
		13	10.135	.065	.31	
		18	10.10	.03	.14	
		22	10.08	.01	.05	

DILLON

IN-SITU HYDRAULIC CONDUCTIVITY TEST

Project Name: MOE CLOSED LANDFILLS File No: 2273-01 Date: Aug 31 88

Borehole No: B-2 Conducted By: SED Page: 1

Static Water Level: 22.10 Measuring Point: T.O.P.

Drawdown at t= 0 (Ho): 23.00 (0.90)

Date	Time (hrs. & mins.)	Elapsed Time (min)	Depth To Water (m)	Drawdown, H (m)	H/Ho	Remarks
		0	22.10	0	0	
		.66	22.70	.60	.666	
		.83	22.64	.54	.60	
		1	22.59	.49	.54	
		1.25	22.54	.44	.49	
		1.50	22.50	.40	.44	
		1.75	22.47	.37	.41	
		2.00	22.45	.35	.39	
		2.25	22.41	.31	.34	
		2.5	22.39	.29	.32	
		2.75	22.38	.28	.31	
		3	22.36	.26	.29	
		3.5	22.33	.23	.26	
		3.75	22.32	.22	.24	
		4.00	22.31	.21	.23	
		4.25	22.30	.20	.22	
		4.50	22.30	.20	.22	
		5	22.29	.19	.21	
		6	22.28	.18	.20	
		7	22.275	.175	.194	
		8	22.27	.17	.190	
		22	22.26	.16	.180	
		30	22.25	.15	.17	
		75	22.225	.125	.14	

APPENDIX F
WATER QUALITY DATA

BARRINGER MAGENTA
304 CARLINGVIEW DRIVE
REXDALE, ONTARIO
M9W 5G2
(416) 675-3870

FILE: 88-4513
DATE: 12/10/88
MATRIX: AQ

Q.L.

M.M.DILLON (KIRA ONYSKO) PROJ:2273-01 WO NO: 88-4513 PAGE: 1

SAMPLE ID	AG MG/L	AL MG/L	B MG/L	BA MG/L	BE MG/L	CA MG/L	CD MG/L	CO MG/L	CR MG/L	CU MG/L	FE MG/L	K MG/L
1001 B-1	.006	<.01	.908	<.005	<.0005	594	<.01	<.05	.03	<.008	.26	8.8
1002 B-2	<.005	<.01	40.1	<.005	<.0005	1230	<.01	<.05	<.01	<.008	.58	92.7
1003 L-1	.012	<.01	.366	.031	<.0005	242	.01	.10	.04	.012	.19	13.5
1004 RES-1	<.005	<.01	.044	.093	<.0005	136	<.01	<.05	.02	.141	1.33	10.0
1005 RES-2	.007	.05	.152	<.005	<.0005	492	<.01	.07	.02	.030	.23	4.6
1006 MILL	<.005	<.01	.037	.114	<.0005	145	.01	<.05	.02	<.008	.09	28.8
1007 MUNC	<.005	.10	.151	<.005	<.0005	494	.01	.06	.03	.011	.05	3.1
1008 P-6	<.005	.02	<.004	<.005	<.0005	.27	<.01	.07	<.01	<.008	<.01	.5
1009 P-100	<.005	<.01	.183	<.005	<.0005	571	<.01	<.05	.03	.018	.10	3.2
CONTROL DATA	--	--	--	--	--	--	--	--	--	--	--	--
BLANK	.006	.02	.005	<.005	<.0005	.16	<.01	.06	<.01	<.008	<.01	.8
1001 B-1	.006	<.01	.908	<.005	<.0005	594	<.01	<.05	.03	<.008	.26	8.8
1001 B-1-R	<.005	<.01	.875	<.005	<.0005	577	<.01	<.05	.04	<.008	.27	8.4
CONTROL STD	<.005	.99	.194	.998	.0189	<.01	.20	.18	.20	.203	.98	<.5
CONTROL.EST.	--	1.00	.200	--	.0200	--	.20	.20	.20	.200	1.00	--
EPA STD	<.005	.04	.105	<.005	<.0005	39.8	<.01	<.05	<.01	<.008	.08	9.7
EPA.STD(CRT)	--	--	--	--	--	40.0	--	--	--	--	--	10.0

BARRINGER MAGENTA

REXDALE, ONTARIO
M9W 5G2
(416) 675-3870

FILE: 10_4513
DATE: 12/10/88
MATRIX: AQ

M.M.DILLON (KIRA ONYSKO) PROJ:2273-01 WO NO: 88-4513 PAGE: 2

SAMPLE ID	MG MG/L	MN MG/L	MO MG/L	NA MG/L	NI MG/L	P MG/L	PB MG/L	SI MG/L	SR MG/L	TH MG/L	TI MG/L	V MG/L
1001 B-1	72.1	.19	<.2	157	.10	.9	<.05	6.36	10.3	<.05	.006	.011
1002 B-2	463	1.78	<.2	4530	<.05	1.2	<.05	4.97	27.8	<.05	<.005	<.005
1003 L-1	70.4	.11	<.2	36.1	.07	.6	<.05	7.78	1.25	<.05	<.005	.009
1004 RES-1	46.1	.04	.2	24.4	<.05	.5	<.05	4.31	.797	<.05	<.005	<.005
1005 RES-2	46.3	.11	<.2	11.0	.07	.7	<.05	3.91	8.75	<.05	<.005	.008
1006 HILL	46.4	<.01	<.2	63.2	<.05	.5	<.05	4.76	.866	<.05	<.005	.006
1007 MUNC	47.4	<.01	<.2	16.2	.06	.7	<.05	3.68	7.99	<.05	<.005	.009
1008 P-6	.03	<.01	<.2	<.5	<.05	<.5	<.05	<.05	.002	<.05	<.005	<.005
1009 P-100	47.9	<.01	<.2	9.4	.07	.7	<.05	3.39	8.35	<.05	<.005	.017
CONTROL DATA	--	--	--	--	--	--	--	--	--	--	--	--
BLANK	.03	<.01	<.2	<.5	<.05	<.5	<.05	<.05	.003	<.05	<.005	<.005
1001 B-1	72.1	.19	<.2	157	.10	.9	<.05	6.36	10.3	<.05	.006	011
1001 B-1-R	71.0	.18	<.2	158	.09	.8	<.05	5.90	10.2	<.05	<.005	.018
CONTROL STD	<.01	.19	<.2	<.5	.20	<.5	.21	<.05	.202	<.05	.197	.199
CONTROL.EST.	--	.20	--	--	.20	--	.20	--	.200	--	.200	.200
EPA STD	9.98	<.01	<.2	40.0	<.05	<.5	--	.50	.022	<.05	<.005	.007
EPA.STD(CRT)	10.0	--	--	40.0	--	--	--	--	--	--	--	--

BARRINGER MAGENTA
304 CARLINGVIEW DRIVE
REXDALE, ONTARIO
M9W 5G2
(416) 675-3870

FILE: 1d_4513
DATE: 12/10/88
MATRIX: AQ

M.M.DILLON (KIRA ONYSKO) PROJ:2273-01 WO NO: 88-4513 PAGE:

SAMPLE ID	ZN MG/L	ZR MG/L	ALK PPMCACO3	AS UG/L	BOD MG/L	DOC MG/L	HG UG/L	NH3-N MG/L	PH	PHENOLS UG/L
1001 B-1	.08	<.05	336	1	9.5	2.80	.08	.59	7.55	.5
1002 B-2	.11	<.05	626	50	265	74.2	<.05	21.5	8.28	240
1003 L-1	.06	<.05	422	<1	5.5	--	.15	--	7.87	<.5
1004 RES-1	.30	<.05	409	<1	1.5	5.90	.08	.12	7.65	<.5
1005 RES-2	.11	<.05	256	<1	2.5	.75	.08	.05	7.56	.5
1006 MILL	.05	<.05	337	<1	2.0	1.07	.08	<.02	7.47	.5
1007 MUNC	.06	<.05	261	<1	1.0	.35	.12	<.02	7.73	<.5
1008 P-6	<.01	<.05	1.5	<1	.8	.32	.08	.02	6.13	1.8
1009 P-100	.08	<.05	272	<1	1.0	.70	.12	.02	7.71	30.2
CONTROL DATA	--	--	--	--	--	--	--	--	--	--
BLANK	<.01	<.05	2.3	<1	<.1	<.02	<.05	<.02	5.45	<.5
1001 B-1	.08	<.05	336	1	9.5	2.80	.08	.59	7.55	.5
1001 B-1-R	.07	<.05	340	1	8.5	2.90	.08	.60	7.68	.5
CONTROL STD	.20	.20	51.5	--	5.9	9.70	3.44	.52	4.46	9.5
CONTROL.EST.	.20	.20	50.0	--	6.0	10.0	3.20	.50	4.45	10.0
EPA STD	.02	<.05	--	43	--	--	--	--	--	--
EPA.STD(CRT)	--	--	--	45	--	--	--	--	--	--

BARRINGER MAGENTA

[illegible]RLING[illegible]IVE
REXDALE, ONTARIO
M9W 5G2

(416) 675-3870

[illegible]E: [illegible]
DATE: 12/10/88
MATRIX: AQ

M.M.DILLON (KIRA ONYSKO) PROJ:2273-01 WO NO: 88-4513 PAGE: 4

SAMPLE ID	F- MG/L	CL- MG/L	NO2-N MG/L	BR- MG/L	NO3-N MG/L	PO4-3 MG/L	SO4= MG/L
1001 B-1	<1.00	121	<1.00	1.14	<.10	<1.0	1550
1002 B-2	<1.00	10400	<1.00	100	<.10	<1.0	2460
1003 L-1	<.10	24.5	<.10	.85	6.59	<.1	316
1004 RES-1	<.10	28.2	<.10	<.05	2.91	<.1	167
1005 RES-2	<.10	17.7	<.10	<.05	1.28	<.1	1130
1006 MILL	<.10	164	<1.00	<.05	3.44	<.1	136
1007 MUNC	<.10	28.3	<.10	<.05	.86	<.1	1180
1008 P-6	<.01	.03	<.01	<.05	<.01	<.1	<.05
1009 P-100	<.10	17.4	<.10	<.05	.69	<.1	1140
CONTROL DATA	--	--	--	--	--	--	--
BLANK	<.01	<.01	<.01	<.05	<.01	<.1	<.05
1001 B-1	<.10	121	<1.00	1.14	<.10	<1.0	1550
1001 B-1-R	<.10	127	<1.00	1.14	<.10	<.1	1570
CONTROL STD	1.00	10.2	1.10	1.03	1.98	2.2	20.2
CONTROL.EST.	<.01	10.0	1.00	1.00	2.00	2.0	20.0
EPA STD	--	--	--	--	--	--	--
EPA.STD(CRT)	--	--	--	--	--	--	--

MANN TESTING LABORATORIES LTD.
5550 McADAM ROAD, MISSISSAUGA, ONTARIO L4Z 1P1
PHONE: 890-2555 • TELEX: 06-960496 • FAX: (416) 890-0370

CUSTOMER: M.M. Dillon
47 Sheppard Ave. East
Willowdale, Ontario
M2N 5X5

ATTN: Mrs. Kira Onysko

REPORT #: 882422

CUSTOMER REF.# 2273

DATE SUBMITTED: Sept. 2, 1988

DATE REPORTED: Sept. 28/88

---------- CERTIFICATE OF ANALYSIS ----------

Sample Description: WATER

Analysis Performed: VOLATILE ORGANIC ANALYSIS

Protocol based upon U.S. EPA Method #624.
Samples are fortified with isotopically labelled internal standards and analyzed by purge and trap gas chromatography/mass spectrometry (PT-GC/MS).

Note: Additional information is available on request.

Instrumentation:

- Envirochem 810 purge and trap concentrator.
- Finnigan 3200 GC/MS-DS.

Chemical Results: See Tables V-1, V-2, V-3.

CERTIFIED BY:
Nellie Sio, B. Tech.
Project Leader-Volatile Organics

WITNESSED BY:
Tim Munshaw, M.Sc. C.Chem.
Manager, Environmental Dept.

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
T. Munshaw
CHEMIST

* Refer inquiries to.

2422-V-3
VOLATILE ORGANICS
Conc. = (ppb)

M.M. DILLON
W.O. #882422

PEEBLES
L1

VOLATILE COMPOUNDS	MDL (ppb)	TRAVELLING BLANK(2)	2273-1003		
DICHLORODIFLUOROMETHANE	2.0	--	--	--	--
CHLOROMETHANE	2.0	--	--	--	--
VINYL CHLORIDE	2.0	--	--	--	--
BROMOMETHANE	2.0	--	--	--	--
CHLOROETHANE	2.0	--	--	--	--
TRICHLOROFLUOROMETHANE	2.0	--	--	--	--
1,1-DICHLOROETHYLENE	1.0	--	--	--	--
DICHLOROMETHANE	1.0	--	--	--	--
T-1,2-DICHLOROETHYLENE	1.0	--	--	--	--
1,1-DICHLOROETHANE	1.0	--	--	--	--
CHLOROFORM	1.0	--	--	--	--
1,2-DICHLOROETHANE	1.0	--	--	--	--
1,1,1-TRICHLOROETHANE	1.0	--	--	--	--
BENZENE	0.5	5.22	4.49	--	--
CARBON TETRACHLORIDE	1.0	--	--	--	--
1,2-DICHLOROPROPANE	1.0	--	--	--	--
BROMODICHLOROMETHANE	1.0	--	--	--	--
TRICHLOROETHYLENE	1.0	--	--	--	--
1,3-DICHLOROPROPENE(Z)	1.0	--	--	--	--
1,3-DICHLOROPROPENE(E)	1.0	--	--	--	--
1,1,2-TRICHLOROETHANE	1.0	--	--	--	--
TOLUENE	0.5	--	--	--	--
DIBROMOCHLOROMETHANE	1.0	--	--	--	--
TETRACHLOROETHYLENE	1.0	--	--	--	--
CHLOROBENZENE	0.5	--	--	--	--
ETHYL BENZENE	0.5	--	--	--	--
P & M XYLENE	0.5	--	--	--	--
BROMOFORM	1.0	--	--	--	--
O-XYLENE	0.5	--	--	--	--
1,1,2,2-TETRACHLOROETHANE	1.0	--	--	--	--
1,3-DICHLOROBENZENE	1.0	--	--	--	--
1,4-DICHLOROBENZENE	1.0	--	--	--	--
1,2-DICHLOROBENZENE	1.0	--	--	--	--
CIS-1,2-DICHLOROETHYLENE	1.0	--	--	--	--
TOLUENE DISSOCYANATE	100	--	--		
SURROGATE % RECOVERY					
4-BROMOFLUOROBENZENE		75.36%	82.36%		

TR = TRACE AMOUNT DETECTED
-- = NONE DETECTED
MDL = METHOD DETECTION LIMIT

ANALYST [signature], Oct 13/88

2455MISA

MTL QA/QC REFERENCE MATERIAL ANALYSIS
FOR THE PERIOD OF SEPT. 8 - SEPT. 20
U.S. EPA MATERIAL WS1084 - I & IV

VOLATILE COMPOUNDS	MDL (ppb)	EPA REFERENCE MATERIALS			
		EPA VALUES	LAB VALUES	% RECOVERY	
DICHLORODIFLUOROMETHANE	2.0	--	--	--	--
CHLOROMETHANE	2.0	--	--	--	--
VINYL CHLORIDE	2.0	--	--	--	--
BROMOMETHANE	2.0	--	--	--	--
CHLOROLTHANE	2.0	--	--	--	--
TRICHLOROFLUOROMETHANE	2.0	--	--	--	--
1,1-DICHLOROETHYLENE	1.0	10.0	8.87	88.70	--
DICHLOROMETHANE	1.0	--	--	--	--
T-1,2-DICHLOROETHYLENE	1.0	--	--	--	--
1,1-DICHLOROETHANE	1.0	--	--	--	--
CHLOROFORM	1.0	--	--	--	--
1,2-DICHLOROETHANE	1.0	--	--	--	--
1,1,1-TRICHLOROETHANE	1.0	9.9	10.06	101.62	--
BENZENE	0.5	9.82	10.38	105.70	--
CARBON TETRACHLORIDE	1.0	--	--	--	--
1,2-DICHLOROPROPANE	1.0	--	--	--	--
BROMODICHLOROMETHANE	1.0	--	--	--	--
TRICHLOROETHYLENE	1.0	--	--	--	--
1,3-DICHLOROPROPENE(Z)	1.0	--	--	--	--
1,3-DICHLOROPROPENE(E)	1.0	--	--	--	--
1,1,2-TRICHLOROETHANE	1.0	10.1	6.46	63.96	--
TOLUENE	0.5	--	--	--	--
DIBROMOCHLOROMETHANE	1.0	--	--	--	--
TETRACHLOROETHYLENE	1.0	10.0	7.46	74.6	--
CHLOROBENZENE	0.5	--	--	--	--
ETHYL BENZENE	0.5	10.0	10.80	108	--
P & M XYLENE	0.5	9.8	9.69	98.88	--
BROMOFORM	1.0	10.2	6.74	66.08	--
O-XYLENE	0.5	--	--	--	--
1,1,2,2-TETRACHLOROETHANE	1.0	--	--	--	--
1,3-DICHLOROBENZENE	1.0	--	--	--	--
1,4-DICHLOROBENZENE	1.0	10.0	7.96	79.60	--
1,2-DICHLOROBENZENE	1.0	--	--	--	--
CIS-1,2-DICHLOROETHYLENE	1.0	10.2	7.33	71.86	--
ACROLEIN	15.0	--	--	--	--
ACRYLONITRILE	15.0	--	--	--	--
DIBROMOMETHANE	1.0	--	--	--	--
1,2-DIBROMOETHANE	1.0	--	--	--	--
1,3-BUTADIENE	2.0	--	--	--	--
STYRENE	1.0	--	--	--	--
PROPYL BENZENE	0.5	--	--	--	--
CUMENE	0.5	--	--	--	--
4-ETHYL TOLUENE	0.5	--	--	--	--
1,2,4-TRIMETHYL BENZENE	0.5	--	--	--	--
1,4-DIETHYL BENZENE	0.5	--	--	--	--

ANALYST [signature], Sept 29/88

MANN TESTING LABORATORIES LTD.
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Willowdale, Ontario
M2N 5X5

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M.M. DILLON LTD.
TORONTO OFFICE

ATTN: Ms. Kira Onysko

REPORT #: 882422 CUSTOMER REF.# 2273

DATE SUBMITTED: Sept. 2, 1988 DATE REPORTED: Nov. 1, 1988

---------- CERTIFICATE OF ANALYSIS ----------

Sample Description: WATER

Analysis Performed: ORGANO-CHLORINE AND ORGANO-PHOSPHORUS PESTICIDE

The analytical protocol is based upon U.S. EPA Method #8080/1986 Third Edition. Samples are solvent extracted at neutral conditions. The neutral extract is subjected to a florisil chromatographic cleanup procedure and analyzed by dual capillary column, dual electron capture detection gas chromatography (ECD^2/GC) and a nitrogen-phosphorus specific detection (TSD/GC).

Note: Additional information is available on request.

Instrumentation:

- Varian 3500 GC - dual ECD DB-5 0.25 mm I.D. 30, DB-1701 0.25 mm I.D. 30 m.
- Varian 3400 GC - equipped with an effluent splitter coupled with ECD and TSD; DB-17, 0.32 mm I.D. 30 m.

Chemical Results: See Tables 1, 2, 3.

Ewa Pranjic

CERTIFIED BY:
Ewa Pranjic, M.Sc., C.Chem.
Project Leader-Pesticide Section.

T. Munshaw

WITNESSED BY:
Tim Munshaw, M.Sc., C.Chem.

CHARTERED CHEMIST T. Munshaw

2422-2

CHLORINATED PESTICIDES
Conc. = (ppt)

M.M. DILLON
W.O. #882422

PESTICIDE COMPOUNDS	MDL (ppt)	% RECOVERY	PEEBLES L1 2273-2010	PEEBLES L1 2273-1003		
DELTA BHC	20	111	--	--	--	--
ALPHA BHC	20	93	--	--	--	--
BETA BHC	20	100	--	--	--	--
GAMMA BHC	20	101	--	--	--	--
4,4-DDD	20	109	--	--	--	--
4,4-DDE	20	106	--	--	--	--
4,4-DDT	20	100	--	--	--	--
ALDRIN	20	82	--	--	--	--
HEPTACHLOR	20	89	--	--	--	--
DIELDRIN	20	101	--	--	--	--
HEPTACHLOR EPOXIDE	20	110	--	--	--	--
ENDRIN	20	79	--	--	--	--
ALPHA ENDOSULPHAN	20	107	--	--	--	--
BETA ENDOSULPHAN	20	100	--	--	--	--
ENDOSULPHAN SULPHATE	20	106	--	--	--	--
ENDRIN ALDEHYDE	20	74	--	--	--	--
TOTAL PCB	500	98	--	--	--	--

MDL = METHOD DETECTION LIMIT
-- = NONE DETECTED
TR = TRACE AMOUNT DETECTED

ANALYST G. Proulx NOV 1/88

2422-3

ORGANOPHOSPHORUS HERBICIDES
Conc. = (ppt)

M.M. DILLON
W.O. #882422

PESTICIDE COMPOUNDS	MDL (ppb)	% RECOVERY	BLANK	2273-2018	2273-2009	2273-2010	PEEBLES L1 2273-1003
DIAZINON	1.0	79	--	--	--	--	--
PARATHION METHYL	2.0	82	--	--	--	--	--
MALATHION	2.0	82	--	--	--	--	--
PARATHION ETHYL	2.0	83	--	--	--	--	--
CARBARYL	20.0	80	--	--	--	--	--
GUTHION	10.0	84	--	--	--	--	--

MDL = METHOD DETECTION LIMIT
-- = NONE DETECTED
TR = TRACE AMOUNT DETECTED
ppb = ug/l

ANALYST E. Prangé NOV 1/88